Diversifying STEM Curricula at Queen Mary University of London

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October 28, 2024

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1   Introduction

These notes are the result of an initial EDI summer project run in July and August 2022 with the help of a group of PhD students and postdocs within the School of Mathematical Sciences: Adam Onus, Bolys Sabitbek, Christo Morison, Evelyn Lira Torres, Julio Argota Quiroz and Maria Pintado Serrano. From 2023 onwards, it has been expanded to the School of Engineering and Materials Science and is being led by Dr. Rehan Shah and supported by Dr. Saqib Jivani and Ava Dahlia Belafonte.

We have collected some short biographies of mathematicians belonging to a diverse background to defy the idea that mathematics has been and is made by white European men with beards. The biographies are collected under the following groups:

- African mathematicians

- African-American mathematicians

- Caribbean mathematicians

- Ancient Islamic mathematicians

- Asian mathematicians

- Latin American mathematicians

- Australian Oceanian mathematicians

- Disabled mathematicians

- Female mathematicians

- Queer mathematicians

Feel free to make use of these notes in your own lectures to mention mathematicians relevant to your modules. If you have any suggestions on how to improve these notes or if you would like to suggest other possible profiles, please write an email to `rehan.shah@qmul.ac.uk` or `c.garetto@qmul.ac.uk`.

Suggested People for QMUL Courses

First Year - SEMS

Computational and Mathematical Modelling 1

- James Stewart
- Maria Agnesi
- Mary Fairfax Somerville
- Hypatia of Alexandria
- Mary Clem
- Dr Gladys West
- Peter Landin
- The ENIAC Six: Betty Holberton, Jean Jennings Bartik, Kay McNulty, Marlyn Wescoff, Ruth Lichterman, Frances Bilas Spencer
- Lofti Aliasker Zadeh
- Katherine Johnson
- Ada Lovelace

Computational and Mathematical Modelling 2

- Nalini Joshi
- Chris Matthews
- Solomon Lefschetz
- Argelia Vélez Rodríguez
- Karen Uhlenbeck
- Imelda Trejo
- Luis Ángel Caffarelli
- Artur Avila Cordeiro de Melo
- Rudranath Capildeo
- The ENIAC Six: Betty Holberton, Jean Jennings Bartik, Kay McNulty, Marlyn Wescoff, Ruth Lichterman, Frances Bilas Spencer
- Taqi ad-Din Muhammad ibn Ma'ruf ash-Shami al-Asadi
- Ada Lovelace

First Year - SMS

Calculus I and II

- James Stewart
- Maria Agnesi
- Alberto Pedro Calderón
- Mary Fairfax Somerville
- Charles Costley
- Thomas Fuller

Computing and Data Analysis with Excel

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- Sian Lewis
- Nergis Mavalvala

Introduction to Algebra

- Tyler Kelly
- Emily Riehl
- Alex Fink
- Ruth Moufang
- Emmy Noether
- Jose Adem
- Samuel Gitler

- Ernesto Lupercio Lara
- Laila Soueif
- Abu Ja'far Muhammad ibn Musa Al-Khwarizmi
- Hossein Zakeri
- Walled As Salam
- Claire Voisin

Introduction to Probability

- Alicia Dickenstein

Numbers, Sets and Functions

- Eugenia Cheng
- Ludwig Wittgenstein

- Khalida Noor

Probability and Statistics I

- Kathleen Ollerenshaw
- Ruth Fairclough
- David Blackwell

- Florence Nightingale
- Nira Chamberlain

Vectors and Matrices

- Hypatia of Alexandria
- Rudranath Capildeo

Second Year - SEMS

Numerical Methods and Data Science

- Caryn Navy
- Ruth Fairclough

- Audrey Tang
- Sian Lewis

- Alan Turing
- Antonia Jones

- Dr Gladys West
- Peter Landin

Second Year - SMS

Differential Equations

- Nalini Joshi
- Chris Matthews
- Solomon Lefschetz
- Argelia Vélez Rodríguez
- Karen Uhlenbeck

- Imelda Trejo
- Luis Ángel Caffarelli
- Artur Avila Cordeiro de Melo
- Sun-Yung Alice Chang

Introduction to Computer Programming

- Caryn Navy
- Ruth Fairclough
- Audrey Tang
- Sian Lewis
- Alan Turing
- Peter Landin

- The ENIAC Six: Betty Holberton, Jean Jennings Bartik, Kay McNulty, Marlyn Wescoff, Ruth Lichterman, Frances Bilas Spencer
- Lofti Aliasker Zadeh
- Katherine Johnson
- Ada Lovelace

Linear Algebra I

- Ingrid Daubechies

- Diophantus of Alexandria

Actuarial Mathematics I

- Ruth Fairclough

Complex Variables

- Ruth Moufang

Convergence and Continuity

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- Mary Fairfax Somerville
- James Stewart

Differential and Integral Analysis

- James Stewart
- Karen Uhlenbeck
- Alberto Pedro Calderón
- Charles Costley

Introduction to Differential Geometry

- Tyler Kelly
- Marina Logares
- Maryam Mirzhakani

Linear Programming and Games

- Manil Suri

Number Theory

- Antonia Jones
- Diophantus of Alexandria
- Omar Khayyam
- Srinivasa Aiyangar Ramanujan
- Ghiyath al-Din al-Kashani
- Cahit Arf
- Sophie Germain
- Maryna Sergiivna Viazovska

Statistical Modelling I

- Imelda Trejo

Third Year - SMS

Algorithmic Graph Theory

- Alex Fink
- Jinyoung Park

Communicating and Teaching Mathematics

- Eugenia Cheng
- Chris Matthews
- Kathleen Ollerenshaw
- Ron Buckmire
- Argelia Velez-Rodriguez
- Francis Kofi Ampenyin Allotey
- Euclid of Alexandria
- Martha Euphemia Lofton Haynes

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- Kelly Miller

Complex Networks

- Ruth Fairclough

Cryptography

- Antonia Jones
- Alan Turing

Financial Mathematics I

- Ron Buckmire

Financial Mathematics II

- Ron Buckmire

Introduction to Machine Learning

- Antonia Jones

Partial Differential Equations

- Nalini Joshi
- Luis Ángel Caffarelli
- Marina Logares
- Artur Avila Cordeiro de Melo
- Manil Suri
- Shing-Tung Yau
- Karen Uhlenbeck
- Imelda Trejo
- Sun-Yung Alice Change

Coding Theory

- Emily Riehl
- Alan Turing

Metric Spaces and Topology

- Caryn Navy
- Samuel Gitler
- Solomon Lefschetz
- Ernesto Lupercio Lara
- Jose Adem
- Bernard Morin

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- Lev Pontryagin
- Katrin Wehrheim

- Joshua Allensworth Leslie

Relativity

- Nergis Mavalvala

- Marina Logares

Statistical Modelling II

- Imelda Trejo

People by Identity

African Mathematicians

- Francis Kofi Ampenyin Allotey
- Diophantus of Alexandria
- Euclid of Alexandria
- Thomas Fuller
- Laila Soueif
- Hypatia of Alexandria

African American and Black British Mathematicians

- Nira Chamberlain
- Martha Euphemia Lofton Haynes
- Kelly Miller
- Katherine Johnson
- Sian Lewis
- David Blackwell

Caribbean Mathematicians

- Charles Costley
- Rudranath Capildeo
- Argelia Velez-Rodriguez
- Joshua Allensworth Leslie

Islamic Mathematicians

- Abu Ja'far Muhammad ibn Musa Al-Khwarizmi
- Omar Khayyam
- Ghiyath al-Din al-Kashani
- Abu Wafa Muhammad al-Buzanji
- Taqi ad-Din Muhammad ibn Ma'ruf ash-Shami al-Asadi
- Abul-Hasan Kūshyār ibn Labbān ibn Bashahri Daylami

East Asian Mathematicians

- Audrey Tang
- Sun-Yung Alice Chang
- Shing-Tung Yau
- Jinyoung Park
- Eugenia Cheng (British)

South Asian Mathematicians

- Manil Suri
- Nergis Mavalvala
- Nalini Joshi (Australian)
- Baudhāyana

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- Srinivasa Aiyangar Ramanujan
- Khalida Noor
- Subrahmanyan Chandrasekhar

- Asghar Qadir
- Muneer Ahmed Rashid
- Mohammad Abdus Salam

Middle Eastern Mathematicians

- Hossein Zakeri
- Lofti Aliasker Zadeh
- Sediq Afghan

- Walled As Salam

- Cahit Arf

Latin American Mathematicians

- Jose Adem
- Alicia Dickenstein
- Samuel Gitler
- Artur Avila Cordeiro de Melo
- Alberto Pedro Calderón

- Luis Ángel Caffarelli
- Ernesto Lupercio Lara
- Imelda Trejo
- Argelia Vélez Rodríguez
- Ron Buckmire

Indigenous Australian Mathematicians

- Chris Matthews

Jewish Mathematicians

- Emmy Noether
- Solomon Lefschetz
- Caryn Navy

- Ludwig Wittgenstein

- Samuel Gitler

Disabled Mathematicians

- Ruth Fairclough
- Antonia Jones
- Kathleen Ollerenshaw
- Solomon Lefschetz

- Caryn Navy

- Bernard Morin

- Lev Pontryagin

Women in Mathematics

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- Maryam Mirzhakani
- Laila Soueif
- Martha Euphemia Lofton Haynes
- Claire Voisin
- Ingrid Daubechies
- Sofia Kovalevskaya
- Katherine Johnson
- Ada Lovelace
- Maria Agnesi
- Sophie Germain
- Hypatia of Alexandria
- Maryam Mirzhakani
- Ruth Moufang
- Emmy Noether
- Mary Fairfax Somerville
- Maryna Sergiivna Viazovska
- Sian Lewis
- Marina Logares
- Nergis Mavalvala
- Emily Riehl

- Ruth Fairclough
- Antonia Jones
- Kathleen Ollerenshaw
- Caryn Navy
- Sun-Yung Alice Chang
- Jinyoung Park
- Eugenia Cheng
- Nalini Joshi
- Imelda Trejo
- Alicia Dickenstein
- Argelia Vélez Rodríguez
- Karen Uhlenbeck
- Fatma Moalla
- Mary Clem
- Florence Nightingale
- Dr Gladys West
- The ENIAC Six: Betty Holberton, Jean Jennings Bartik, Kay McNulty, Marlyn Wescoff, Ruth Lichterman, Frances Bilas Spencer

Queer Mathematicians

- Alan Turing
- Alex Fink
- Manil Suri
- Sian Lewis
- Ron Buckmire
- Marina Logares
- Audrey Tang

- Nergis Mavalvala
- Emily Riehl
- Tyler Kelly
- James Stewart
- Antonia Jones
- Ludwig Wittgenstein
- Katrin Wehrheim

- Georg Joachim von Lauchen Rheticus

- Peter Landin

Non-binary and/or Transgender Mathematicians

- Audrey Tang

- Tyler Kelly

Prize Winners

- Francis Kofi Ampenyin Allotey

- Maryna Sergiivna Viazovska

- Claire Voisin

- Nergis Mavalvala

- Ingrid Daubechies

- Shing-Tung Yau

- Maryam Mirzhakani

- Artur Avila Cordeiro de Melo

- Karen Uhlenbeck

- Alberto Pedro Calderón

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People by Field

Geometry

- Euclid of Alexandria
- Omar Khayyam
- Hypatia of Alexandria
- Ruth Moufang
- Maryna Sergiivna Viazovska

- Kathleen Ollerenshaw
- Baudhāyana
- Georg Joachim von Lauchen Rheticus
- Abu Wafa Muhammad al-Buzanji
- Fatma Moalla

Calculus and Differential Equations

- Ingrid Daubechies
- Sofia Kovalevskaya
- Maria Agnesi
- Mary Fairfax Somerville
- Manil Suri
- James Stewart
- Solomon Lefschetz
- Sun-Yung Alice Chang

- Shing-Tung Yau
- Nalini Joshi
- Alberto Pedro Calderón
- Luis Ángel Caffarelli
- Argelia Vélez Rodríguez
- Karen Uhlenbeck
- Charles Costley

Algebra

- Diophantus of Alexandria
- Laila Soueif
- Abu Ja'far Muhammad ibn Musa Al-Khwarizmi
- Ruth Moufang
- Emmy Noether
- Alex Fink

- Emily Riehl
- Eugenia Cheng
- Rudranath Capildeo
- Hossein Zakeri
- Walled As Salam
- Khalida Noor

Topology

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- Solomon Lefschetz
- Caryn Navy
- Jose Adem
- Samuel Gitler
- Ernesto Lupercio Lara

- Bernard Morin
- Lev Pontryagin
- Katrin Wehrheim
- Joshua Allensworth Leslie

Mathematical Physics

- Francis Kofi Ampenyin Allotey
- Marina Logares
- Tyler Kelly
- Shing-Tung Yau
- Ernesto Lupercio Lara
- Karen Uhlenbeck

- Argelia Velez-Rodriguez
- Dr Gladys West
- Subrahmanyan Chandrasekhar
- Asghar Qadir
- Muneer Ahmed Rashid
- Mohammad Abdus Salam

Mathematical Education

- Martha Euphemia Lofton Haynes
- Kelly Miller
- Ron Buckmire
- James Stewart
- Kathleen Ollerenshaw

- Eugenia Cheng
- Chris Matthews
- Argelia Vélez Rodríguez
- Francis Kofi Ampenyin Allotey
- Euclid of Alexandria

Algebraic Geometry

- Claire Voisin
- Tyler Kelly

- Alicia Dickenstein

Differential Geometry

- Maryam Mirzhakani
- Marina Logares

- Karen Uhlenbeck

Number Theory

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- Sophie Germain
- Hypatia of Alexandria
- Mary Fairfax Somerville
- Maryna Sergiivna Viazovska
- Antonia Jones

- Srinivasa Aiyangar Ramanujan
- Diophantus of Alexandria
- Ghiyath al-Din al-Kashani
- Cahit Arf

Computer Programming

- Katherine Johnson
- Ada Lovelace
- Alan Turing
- Sian Lewis
- Audrey Tang
- Antonia Jones
- Mary Clem

- Dr Gladys West
- The ENIAC Six: Betty Holberton, Jean Jennings Bartik, Kay McNulty, Marlyn Wescoff, Ruth Lichterman, Frances Bilas Spencer
- Lofti Aliasker Zadeh
- Peter Landin

Graph Theory and Combinatorics

- Alex Fink

- Jinyoung Park

Cryptography

- Alan Turing

- Antonia Jones

Numerical Analysis

- Manil Suri
- Ron Buckmire

- Chris Matthews

Dynamical Systems

- Artur Avila Cordeiro de Melo

- Alicia Dickenstein

Mathematical Biology

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- Imelda Trejo
- Alicia Dickenstein

Data Analysis

- Sian Lewis
- Ruth Fairclough

Mathematical Logic

- Ludwig Wittgenstein

Actuarial Mathematics

- Ruth Fairclough
- David Blackwell

Trigonometry

- Abul-Hasan Kūshyār ibn Labbān   ibn Bashahri Daylami

Other Mathematics or Other Fields

- Thomas Fuller
- Nira Chamberlain
- Nergis Mavalvala
- Taqi ad-Din Muhammad ibn Ma'ruf ash-Shami al-Asadi
- Kathleen Ollerenshaw
- Florence Nightingale
- Sediq Afghan

African mathematicians

2 Francis Kofi Ampenyin Allotey (1932-2017)

Mathematical Physics

Keywords: Ghanaian, Education

Ghanaian mathematician and physicist, Francis Allotey, was the first black student to be admitted to Princeton's graduate school, where he was awarded his masters and later his PhD in 1966.

As a child, his interest in maths and science was sparked by the biographies sold in his fathers book shop in central Ghana. He later went on to study mathematics at Imperial College before continuing his education at Princeton.

Upon his return to Ghana, Allotey sought to promote physics and mathematics at all levels, he became one of the first founding fellows of the African Academy of Sciences, as well as striving to ensure that Ghana could become one of the only African countries in the International Union of Pure and Applied Physics (IUPAP). As part of his aim to promote maths and science, Allotey also worked alongside the IUPAP to run physics workshops in developing countries. His work in promoting STEM also covered computer science, collaborating with IBM to widen access to these subjects.

In 2004 he was the only African to be featured in the book: 'One Hundred Reasons To Be a Scientist'. He was also awarded the Millenium Excellence award in 2005 by the Ghanaian government and was later featured on their postage stamp. Following his death in 2017, Allotey was given a state funeral in recognition of his contributions to the advancement of science and technology in Ghana.

When speaking about his work to widen access to a mathematical education in Africa, Allotey said, 'without mathematical training Africa would be unable to access the full power of technologies to solve their countries numerous problems. It is time we consistently urged our African youth to learn to contribute significantly by researching into extension of Knowledge in Mathematical Sciences'

Read more on MacTutor.

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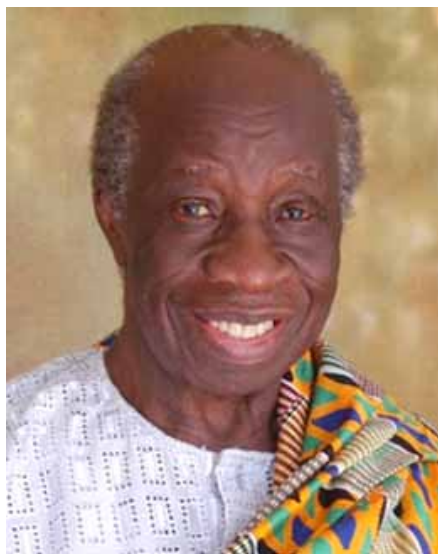
3 Diophantus of Alexandria (200BC - 284BC)

Algebra

Keywords: Historical

Diophantus, the 'father of algebra', is best known for his *Arithmetica*, a work on the solution of algebraic equations and on the theory of numbers. Essentially nothing is known of his life and the date at which he lived (about 200-284 in Alexandria, Egypt) is also not sure.

The *Arithmetica* is a collection of 130 problems giving numerical solutions of determinate and indeterminate equations. The method for solving the latter is now known as Diophantine analysis.

Even if Diophantus is regarded as the 'father of algebra' there is no doubt that many of the methods for solving linear and quadratic equations go back to Babylonian mathematics. Diophantus' work has become famous in recent years due to its connection with Fermat's Last Theorem.

Read more on MacTutor.

4   Euclid of Alexandria (325BC - 265BC)

Geometry

Keywords: Historical

Euclid of Alexandria (325 BCE - 265 BCE) is the most prominent mathematician of antiquity. His treatise on mathematics *The Elements* makes him the leading mathematics teacher of all time. However little is known of Euclid's life except that he taught at Alexandria in Egypt.

The Elements became the centre of mathematical teaching for 2000 years. Probably Euclid did not prove the results in *The Elements* but the organisation of the material and its exposition are due to him.

The Elements begins with definitions and five postulates. The first three postulates are postulates of construction, for example the first postulate states that it is possible to draw a straight line between any two points. These postulates also implicitly assume the existence of points, lines and circles and then the existence of other geometric objects are deduced from the fact that these exist.

Barten van der Waerden, a Dutch mathematician famous for his work in topology and history of mathematics, says: *Almost from the time of its writing and lasting almost to the present,* The Elements *has exerted a continuous and major influence on human affairs. It was the primary source of geometric reasoning, theorems, and methods at least until the advent of non-Euclidean geometry in the 19th century. It is sometimes said that, next to the Bible,* The Elements *may be the most translated, published, and studied of all the books produced in the Western world.*

Read more on Britannica.

5 Thomas Fuller (1710 - 1790)

Calculus

Keywords: Human calculator, Slavery, African, Historical

Thomas Fuller was born in West Africa and brought to Virginia as a slave. We know about him from a report on his mathematical abilities prepared by Dr. Benjamin Rush and published in the American Museum, or Universal Magazine in 1788, and from his obituary, which appeared in the Boston newspaper Columbian Centinel, on December 29, 1790. At some point Fuller was purchased by Presley and Elizabeth Cox, who farmed 232 acres of land four miles west of Alexandria. He remained there the rest of his life, never learning to read or write and receiving no instruction in arithmetic. According to Rush, Fuller told two men who came to interview him late in his life that he taught himself "by counting ten", and that when he was able to count to one hundred, he thought himself "a very clever fellow". Two white men, both Quakers from Pennsylvania, traveled to the Cox farm and posed several problems for him to solve, including how many seconds are in a year and half $(47, 304, 000)$ and how many seconds are in seventy years, seventeen days, and twelve hours $(2, 210, 500, 800)$. One of the men argued that the second solution was too large, but Fuller reminded him of leap years. A third question involved the increase of farm animals, and all questions were solved correctly, within a minute or two, and without the aid of paper or pencil. For this reason, he was called "the human calculator".

Read more on MacTutor.

6 Laila Soueif (1956 - present)

Algebra

Keywords: Woman, Activist, Egyptian

Laila Soueif (1956-) is an Egyptian mathematician and professor of mathematics at Cairo University. She is an activist for human rights together with her husband and their three kids, advocating for academic freedom at Cairo University.

After the award of her Master's Degree in algebra at the University of Cairo she was awarded a Ph.D. scholarship to support her studies at the University of Poitiers in France. She left Egypt for Poitiers with a very young child. Here she worked on the thesis *Transfer of properties in normalizing extensions* under the supervision of Annie Page. Laila describes Annie fondly: *My supervisor Annie Page turned out to be great. She was reserved, but she liked me a lot. And she took no excuses. She'd done her Ph.D. as a single mother with two children, and she worried that I wouldn't focus, especially with my young son.* In 1989 she was appointed to a tenured professorship in mathematics at Cairo University. Laila and her husband, Ahmed Seif, had been Egypt's most celebrated political dissident couple for well over a decade, and constant nuisances to the Mubarak government. Soueif was a founder of the political movement Kefaya and a co-founder of the '9 March Movement for the Independence of Universities', which fought for the democratic election of university presidents and deans.

Read more on MacTutor and her webpage.

African-American and Black British mathematicians

7 Nira Chamberlain (1969 - present)

Data science, Mathematical models, Simulation algorithms

Keywords: Black British, Latin American heritage, Non-linear path, Non-academic career, Dissemination of Mathematics

Prof Nira Chamberlain OBE is a British born with Jamaican heritage mathematician (1969-). Nira grew up in Birmingham and always enjoyed mathematics during his studies. Regardless of the lack of encouragement given by their teachers to pursue mathematics, Nira was supported by his family and studied a BSc in Mathematics at Coventry Polytechnic (1991), MSc in Industrial Mathematical Modelling at Loughborough University (1993). While working several positions on the industry he did his part time PhD at Portsmouth University, entitled "Extension of the gambler's ruin problem played over networks". Later received the Degree of Doctor of Science *honoris causa* by the University of Greenwich (2018), University of Bath (2022) and University of West England (2022). In 2022, he received an OBE in the New Years Honours List for Services to Mathematical Sciences.

His international career was in France, Netherlands, Israel but also throughout the UK. Where in the UK was in charge of the creation of a mathematical cost capability trade-off model for the HMS Queen Elizabeth. Among Nira honours and awards are: Big Math Off - World's Most Interesting Mathematician, Powerlist 2018 5th Most Influential Black Person in the UK, Top 100 Most Influential BAME Leaders in UK Tech Sector (2019), Honorary Member of the Mathematical Association (2020), Fellow of African Scientific Institute (2021) and The First Black (of African diaspora) President of The Mathematical Association (2023).

Right now is Principal Business Modelling Consultant at SNC-Lavalin Atkins and has been nominated for FIN-Forbes Best of Africa - Mathematician of the Year Award (2023).

Read more on Bath, Speakers for schools, York, Wikipedia, LMS, Twitter and Linked In.

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8 Martha Euphemia Lofton Haynes (1890 - 1980)

Mathematics Education

Keywords: Women, African American

Euphemia Lofton Haynes (1890-1980) was a mathematician and educator from the U.S. who was awarded a Ph.D. by the Catholic University of America in 1943, the first African-American woman to earn a Ph.D. in mathematics.

Lofton Haynes graduated with a Bachelor's degree in mathematics in 1914 from Smith College, before embarking upon a career as an educator. She taught mathematics and English at the elementary school, high school and college levels in Washington D.C. After obtaining a Master's degree in education in 1930 from the University of Chicago, she continued teaching until her fifties, when she began her academic research career. At the age of 53, this research culminated in her Ph.D. thesis, *The Determination of Sets of Independent Conditions Characterizing Certain Special Cases of Symmetric Correspondences.*

Lofton Haynes was a pioneer for African-American education in D.C. for many decades, serving on the D.C. Board of Education for eight years, including two years as president.

"Dr. Haynes vigorously advocated for poor students and better schools with high academic standards. She denounced the system's de facto segregation and worked to overturn the District's tracking system, which many felt unfairly locked African-American students into non-educational vocational programs."

Read more on MacTutor and these archives.

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9 Kelly Miller (1863 - 1939)

Mathematics Education

Keywords: African American, Historical

Kelly Miller (1863-1939) was a mathematician, sociologist, essayist, newspaper columnist and author. Miller earned a Bachelor of Science degree from Howard university in 1886 and was appointed as a professor at Howard in 1890, despite having to cut short his Ph.D. work at Johns Hopkins University (as the first African-American admitted) due to financial restrictions.

In 1895, Miller was appointed as a professor of sociology at Howard, a change he made because he felt that the African-American college students *"...needed to be awakened to a realization of the problems of the race and an interest in their solution. To this end, there being no sociology in Howard's curriculum, [Miller] skillfully mixed a study of race problems with mathematics in his classes. When a course was completed all the students were keenly conscious of the American social situation, although what they knew about mathematics was often very doubtful."*

Miller's strength in sociology was his ability to precisely identify and define arguments and their counter-arguments; a skill which was attributed to his strong mathematical background. In 1907, he became the Dean of Arts and Science, having continued to teach both mathematics and sociology, while publishing essays, books and newspaper articles (including a weekly column that appeared in over one hundred newspapers from 1920-1940). He continued to work to better the education of African Americans until his death in the late thirties.

Read more on MacTutor.
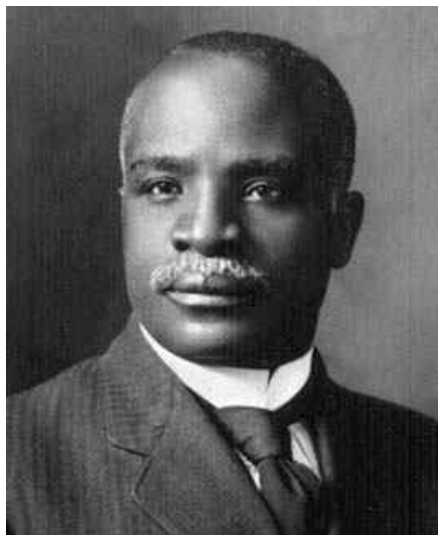
10 David Blackwell (1919 – 2010)

Statistics, Probability, Economics

Keywords: Black, African-American, Statistics, Probability, Awards, Finance

Blackwell was born in Illinois in April 1919 and attended one of the few integrated schools at the time. This is when Blackwell's talent became evident.

He later went onto attend the University of Illinois with the intention of becoming an elementary school maths teacher, and by the age of 22 he had achieved his Ph.D in mathematics and was the seventh African-American in the United States to earn this.

In 1942, Blackwell sought to work as a professor and despite the fact that he was highly recommend was rejected by all but three out of one-hundred and four universities he had applied for. This can be put down to the extreme racial bias that was present in a country where segregation was still present, and still would be, for another 12 years. The impact of racism would follow Blackwell throughout his career, banning him from lectures, ostracising him from his colleagues and much more. However he did not let this stop him from pursuing a career in mathematics.
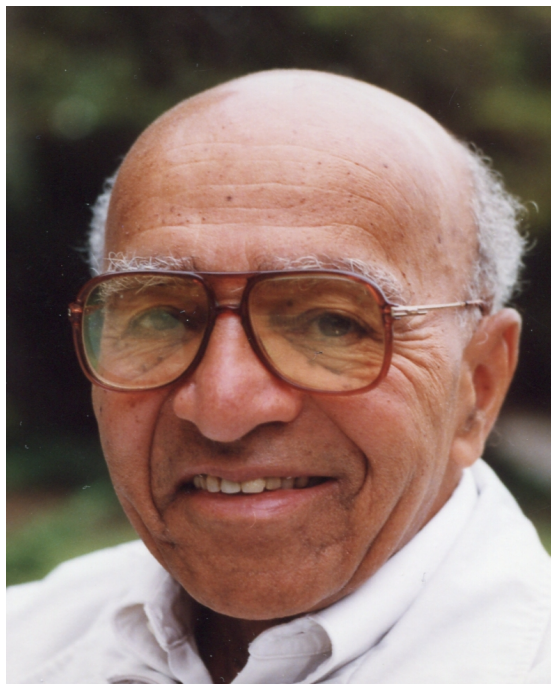
Blackwell is known for his invention of discounted dynamic programming. This method is used in decision making, especially within finance to optimise investments, risk management and capital budgeting. In addition to this, he also developed the Rao-Blackwell Theorem, which is a statistical theorem used find ways to improve estimators using conditional expectations. This is especially utilised in econometrics, machine learning and experimental design. He also wrote one of the first Bayesian textbooks in 1969, which seeks to link probability with previous experiments and personal beliefs.

In 1965 he became the first African American named to the National Academy of Sciences, and then in 1979, was the winner of the John Von Neumann Theory Prize. Over his life he accumulated 12 honorary degrees and even after his death was still being recognised for his work. In 2010 he was posthumously awarded the National Medal of Science by Barack Obama.

Read more on The University of St Andrews Website

Caribbean Mathematicians

11 Argelia Velez-Rodriguez (1936 – present)

Applied Maths, Teaching Methods

Keywords: Female, Black, Cuban, Applied Maths

Born in Cuba, at a time of great political instability and being the daughter of the congressman, Rodriguez always demonstrated an impressive aptitude for maths, winning her first maths competition at the age of 9. Unlike many countries at the time, Cuba was not known for widespread racism or sexism, so faced less opposition to pursuing her degree and graduated from the Mariano Institute in 1955 and continued her studies in Havana. The majority of her teachers here were all women with doctorate, however, there were no black females in Cuba at the time who had earnt this. Rodriguez would be the first.

In 1960, she earnt her Ph.D in Mathematics having written her dissertation in the Determination of Orbits using Talcott's Method, whilst studying for this, she gave birth to her second daughter. Rodrigues later left Cuba for the US in 1962, after Castro took over the Cuban government and began the restructuring of the government system. Despite having now left the communist Cuba, Rodrigues now faced the prevalent bias against black women in the States.

During the 70's, Rodrigues made it her aim to improve the science and mathematics teaching programmes and was heavily involved with the National Science Foundation and mainly teaching at schools and universities for black students. Her goal was to hone and develop teaching methods aimed at minority groups to increase their access to a maths education. Then in 1980 she was appointed the director of the Minority Science Improvement Programme of the U.S Department of Education.

Read more in this article

12   Charles Costley (1928-1997)

Calculus

Keywords:Jamaican, Black, Integration, Caribbean

Costley was born in Kingston, Jamaica where he studied and later qualified as a teacher in 1949. He later moved to Nashville in 1953 where he opted to study Maths at Fisk University. Here he formed a close relationship with Lee Lorch. Lorch then was fired from Faish due to the rise in McCarthyism in the US. In a show of support for Lorch, Costley led a student protest, Lorch then helped Costley win a scholarship the university of Illinois.

In the late 50's, Costley worked on Integral equations and Carleman Operators in order to gain his Ph.D. Making him one of the first Jamaicans to earn a Ph.D. in maths, whilst at the same time working as a train operator in order to provide for newborn and wife. During the 70's he further developed his research on Integral equations that he carried out during his Ph.D. student years.

Costley was a passionate and involved teacher, who was known for doing the most for his students, using his past experience of high school teaching to guide students struggling with the stresses of a high workload in a mathematics degree.

Never straying far from his roots, Costley regularly returned to Jamaica during his sabbaticals with the aim of widening access to maths in Jamaica.

Read more here

13 Rudranath Capildeo (1920 – 1970)

Applied Maths, Mechanics, Vector Algebra

Keywords: Trinidad, Awards, Caribbean, Applied Maths

Capildeo is best known for being the leader of the Democratic Labour party (DLP) from 1960-1969 and the first leader of the opposition in the parliament of an independent Trinidad and Tobago. However, his contributions to mathematics cannot be ignored.

In 1938, he won the island scholarship to Queen's Royal College in the Port of Spain and then later went on to study at the University of London and earnt his Ph.D in Mathematical physics. His main focus was in the time and space and he was hugely inspired by Einstein's work on the theory of Relativity. This led to the beginning of Capildeo's Theory of Rotation and Gravity, otherwise known as Capildeo's Theory as well as his research into 'The Flexure Problem in Elasticity'. All of these have useful applications in aerodynamics and were used in the early space expeditions in the 60s and 70s.

Before his entry into politics, Capildeo spent most of his time teaching at UCL, the University of Sudan as well as being the first principal of Trinidad Polytechnic school, where he wrote a textbook called, Vector Algebra and Mechanics: Theory, Problems and Solutions.

Following his maths career, Capildeo then became a practicing barrister in Trinidad and founded the DLP following Trinidad and Tobago being granted independence. In 1969 he was awarded the Trinity Cross for his contributions to science from the government of Trinidad and Tobago.

Read more on his Wikipedia page
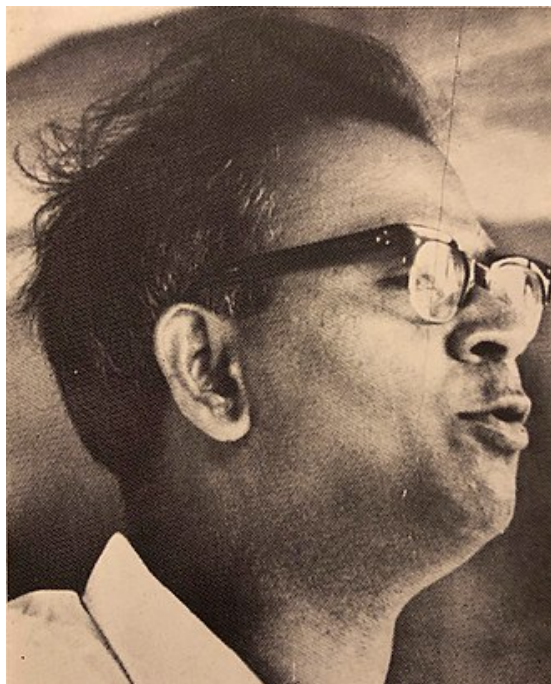
14 Joshua Allensworth Leslie (1933 - present)

Topology

Keywords: Black, Caribbean, Jamaican

Born in Kingston, Jamaica, at the age of 3 Leslie moved and his family moved to New York By 1954 he had earnt his degree in mathematics, where he was inspired by the Parisian mathematician, Henri Cartan. This motivated his move to Paris in 1954 to study under him, and later received his Ph.D from the University of Paris.

He later taught at the University of Ibadan in Nigeria and during this time published the majority of his papers. These mainly focused on algebraic topology and algebraic simplification. These papers meant that his intelligence was being recognised and he then invited to the Institute of Advanced Study at Princeton. He then moved back the US in 1970 in order to look after his mother, where he taught at Berkeley.

Following his move, recognition for his work and abilities only continued to grow, with him being awarded a Major Research Instrumentation Grant, which he used to continue his work in topology and group theory to solving differential equations. In 1988, he was then made a member of the Institute for Advanced Study and in the 1995 put himself forward to be a member of the American Mathematical Society.

Another notable trait of Leslie's was his support and aim to open up maths to minority groups and women, who were incredibly under-represented and was known to voice his concerns about the obstacles preventing their access to a maths education. In a statement to the Mathematical society, he said that 'the question of affirmative action in academia will be a setback for women and minority mathematicians long before its goals will have been met,' and that 'the future of minorities and science is synonymous with the future of the science and the U.S'. Leslie wanted to prove that mathematics could be used a method of social mobility and was just as attainable as all the careers being marketed towards minorities.

Read more in this article

Ancient Islamic mathematicians

15   Abu Ja'far Muhammad ibn Musa Al-Khwarizmi (c.780 – c.850)

Algebra

Keywords: Muslim, Historical

Al-Khwarizmi was an Islamic mathematician and astronomer during the 8th and 9th centries. Al-Khwarizmi is recognised for his contributions to Hindu-Arabic numerals and for his treatise *Hisab al-jabr w'al-muqabala*, which is the first recorded text on the topic of algebra. In the book, Al-Khwarizmi introduced algebraic operations *al-jabr* and *al-muqabala* to simplify quadratic equations, which he then solved with the geometric picture of "completing the square" that is now taught in schools. The Latinised translations of "Al-Khwarizmi" and "al-jabr" in the 12th century gave us the origin of the words "algorithm" and "algebra" respectively.

Little is know about Al-Khwarizmi's life, other than that he worked in the House of Wisdom in Baghdad. Here, he and his colleagues (the Bana Musa brothers) would translate scientific and philosophical manuscripts from Ancient Greek and also publish original research in algebra, geometry and astronomy.

Read more on MacTutor or Encyclopedia Britannica.

16 Omar Khayyam (1048-1131)

Geometry

Keywords: Muslim, Historical

Omar Khayyam (1048-1131) was an Islamic mathematician, astronomer and writer famed for his works of poetry, his creation of astronomical tables and the introduction of geometric methods to solve cubic equations. Among his mathematical achievements, Khayyam is noted for finding a positive root to equation $x^3 + 200x = 2 - x^2 + 2000$ by considering the intersection of a rectangular hyperbola and a circle. In doing this, he stated the solution could not be found by ruler and compass methods, which would be proved by Galois 750 years later. Instead, Khayyam wrote extensively to completely classify cubic equations and their solutions with conic sections.
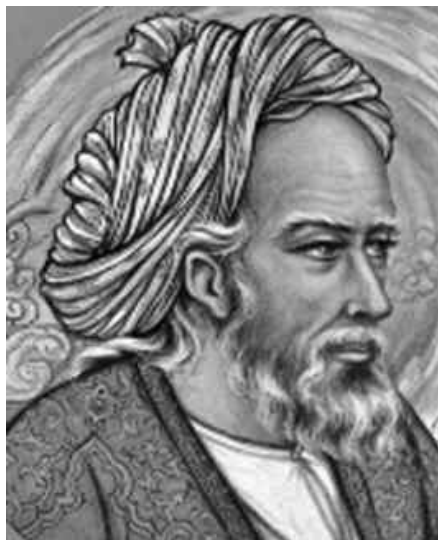
Khayyam's life was marred by many political events, growing up during the occupation of parts of Persia by a military empire of Seljuq Turks. He spent many years living a life of luxury and celebrated for his scientific abilities, before later falling out of favour with the Sultan. Historical recollections state that Khayyam's memory and scientific ability were unmatched at the time. His poetry, written while spending the late years of his life in recluse, was translated from Farsi to English in the 19th century and is renounded for its political and religious themes. Tourists in north-eastern Iran can today visit Khayyam's grave in the mausoleum in Nishapur.

Read more on MacTutor or this Al Jazeera article.

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17   Ghiyath al-Din al-Kashani (1380-1429)

Number Theory

Keywords: Muslim, Historical

Ghiyath al-Din al-Kashani (1380-1429) was skilled in number theory and computations. In 1424, he calculated the value of 2π with great accuracy using a polygon with 805306368 sides as an approximation. He also authored 'Miftah-ul-Hissab' or 'The Calculators' Key,' a book that included a method for finding the fifth root of any number and was used in Persian schools until the seventeenth century.

Later in his life, he was invited to Samarkand to work at a new scientific school and observatory, collaborating with other scholars. Kashani also worked on accurate approximations for trigonometric sine values by solving cubic equations. His work on trigonometry was further advanced by Abu Wafa Muhammad al Buzanji who became the first mathematician to illustrate the universality of the sine theorem concerning spherical triangles.

Read more on MacTutor.

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18 Abu Wafa Muhammad al-Buzanji (940 - 998)

Trigonometry

Keywords: Muslim, Historical

Abu Wafa Muhammad al-Buzanji made significant contributions as a mathematician and astronomer. His notable work extended across various mathematical domains, particularly geometry and trigonometry. In trigonometry, Al-Buzanji's achievements were remarkable. He was the first to demonstrate the generality of the sine theorem involving spherical triangles. He introduced a novel method for creating highly precise sine tables, achieving remarkable accuracy, with values like sin 30 accurate to eight decimal places. He also delved into tangent calculations and devised corresponding tables.

Additionally, he introduced the secant and cosecant functions for the first time. In the field of geometry, he progressed by developing compass-based methods to solve geometric problems, constructing regular hexagons using inscribed equilateral triangles, and coming up with techniques to build parabolas based on points. He also provided geometric solutions for equations such as $X^4 = a$ and $x^2 + ax^3 = b$.

Read more on MacTutor.

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19   Taqi ad-Din Muhammad ibn Ma'ruf ash-Shami al-Asadi (1526-1585)

polymath

Keywords: Muslim, Historical, Turkish

Taqi ad-Din Muhammad ibn Ma'ruf ash-Shami al-Asadi (1526-1585) was a versatile scholar in the Ottoman Empire. He wrote over ninety books on various subjects like astronomy, clocks, engineering, mathematics, mechanics, optics, and natural philosophy. In 1574, the Ottoman Sultan Murad III invited him to establish an observatory in Istanbul. There, Taqi ad-Din used instruments like an armillary sphere and mechanical clocks to observe the Great Comet of 1577. He also used European celestial and terrestrial globes received through gift exchanges.

One of his major achievements from the observatory was a work titled "The tree of ultimate knowledge in the Kingdom of the Revolving Spheres: The astronomical tables of the King of Kings (Murad III)." This book, based on observations in Egypt and Istanbul, built upon Ulugh Beg's 15th-century work, the Zij-i Sultani. It contains calculations, discussions on astronomical clocks, celestial circles, and details about three eclipses observed in Cairo and Istanbul.

Taqi al-Din was also asked to create a clock for accurate call to prayer timing, leading to his first book on building mechanical clocks in 1563, titled "al-Kawakib al-Durriya fi Bengamat al-Dawriyya." He believed this would offer a precise understanding of celestial motions. He learned from European clockmakers and studied clocks in Semiz Ali Pasha's treasury. In the treasury, he examined three types of clocks: those powered by weights, springs, and lever escapements. As Chief Astronomer, he designed a mechanical astronomical clock with three dials, enhancing observations at the Constantinople observatory. Afterward, it's uncertain if he continued his work on mechanical clocks, as much of Ottoman clockmaking came under European influence.

In 1551, Taqi al-Din created an early version of the steam turbine—a self-rotating spit. He also described four water-raising devices, including animal-powered pumps and paddle wheel-driven pumps. His innovative concepts predated many modern engines and laid the groundwork for steam engine development.

Read more on the Muslim Heritage Site.

20   Abul-Hasan Kūshyār ibn Labbān ibn Bashahri Daylami

Trigonometry

Keywords: Ancient, Iranianf

Abul-Hasan Kūshyār ibn Labbān ibn Bashahri Daylami known as Kushyar_e Guilani, was an Iranian scientist whose precise biography is not known; though, most of his contributions to science and in particular, to Mathematics and Astronomy is well preserved and popular. What is sure is that he was born in the last decade of the 10th century in the province of Guilan in Iran and died around 1030, most probably, in Baghdad. So he is one of the scholars in the Islamic Golden Age. Most literature assume that he was a Muslim and some dispute that. This means that religion was not a main concern in his era and where he lived.

Kushyar_e Guilani's main work was an important part of the elaboration of trigonometry, especially spherical trigonometry. He continued the investigations of the 10th-century mathematicians and mostly, astronomer Abul Wáfa, and devoted much space to this in his Zīj (book of astronomical tables) az-Zīj al-Jamī wal-Baligh ("The Comprehensive and Mature Tables"), which incorporated the improved values of the planetary apogees observed by al-Battani elaboration of trigonometry. He excelled using astrolabe and could promote that to much more precise ones.

His works were lost in Iran but was discovered by some 20th-century historian from Russia, Japan, Tajikistan and Europe who could find his works in different libraries around the globe. Now in some parks and scientific institutions in Guilan, one can find sun clocks that claim the idea came from Kuhyar's works.

This text is based on a research project about Kushyar's life, recently done in Guilan-Iran.

Read more on on the Islamic Scientific Manuscripts Initiative site.

Asian mathematicians

21 Sun-Yung Alice Chang (1948 - present)

Partial Differential Equations

Keywords: Women, BAME, Taiwanese

Sun-Yung Alice Chang (1948-) is a Chinese-American mathematician known for her work in geometric type partial different equations and spectral geometry. At a young age Chang moved with her family to the Republic of China in Taiwan during the Communist revolution on the mainland. She completed her education and undergraduate degree in Taiwan, before completing her Ph.D. in 1974 at the University of California, Berkeley. Chang's most notable work, done in collaboration with Paul Yang, studied extremal functions of Sobolev inequalities to solve PDEs of curves on a sphere, and applications of this to compactness and metrics to 3-manifolds.

Since 1980 Chang has held professorships between the University of California and Princeton. Between 1991 and 1994 she served on the selection committee for the Noether Lectures of the Association for Women in Mathematics, and in 1995 she was awarded with the Ruth Lyttle Satter Prize for women in mathematics. In her acceptance speech she stated, *"Since the Satter Prize is an award for women mathematicians, one cannot help but to reflect on the status of women in our profession now. Compared to the situation when I was a student, it is clear that there are now many more active women research mathematicians. I can personally testify to the importance of having role models and the companionship of other women colleagues. However, I think we need even more women mathematicians to prove good theorems and to contribute to the profession."*

Read more on MacTutor or this biography.

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22   Shing-Tung Yau (1949 - present)

Partial Differential Equations; Geometric Analysis

Keywords: BAME, Chinese, Fields Medalist

Shing-Tung Yau (1949-) is a Chinese mathematician who won a Fields Medal in 1982 for his work on differential geometry and partial differential equations. Yau's Fields Medal was awarded for his wide-ranging work in solving open problems such as the Calabi conjecture in algebraic geometry, the positive mass conjecture of general relativity theory, and solutions to the boundary problems of real and complex Monge-Ampère equations. His efforts in solving these and other problems in collaboration with the likes of Karen Uhlenbeck, Clifford Taubes and Richard Schoen helped firmly establish the field of geometric analysis. In fact, Yau was (somewhat controversially) a part of the team that verified Perelman's proof of the Poincaré conjecture with Ricci flows.

Yau's family fled to Hong Kong during the Chinese communist revolution. In his early years he was the leader of a street gang and did not enjoy his education, but his father later helped instill an interest in philosophy and mathematics. He later dropped out of his undergraduate at Chung Chi College in Hong Kong, but was still encouraged by one of his lecturers to apply for an internship to allow him to study a Ph.D. at Berkeley. As his career progressed, Yau also spent a lot of time and money (out of his own pocket) to establish student scholarships and donate many academic resources. Of particular note is his work in developing Chinese mathematics; being involved in the formation of institutions in Hong Kong, Beijing and Hangzhou, and now sitting as head of Tsinghua University.

Read more on MacTutor.

23   Jinyoung Park (1982 - present)

Combinatorics

Keywords: Women, BME, Korean, Non-linear career

Jinyoung Park is a South Korean mathematician at Stanford University working in combinatorics and graph theory. In 2022, she rose to fame alongside Huy Tuan Pham after publishing a short and succinct proposed proof to the Kahn–Kalai conjecture, which determines a universal expected upper bound for random graphs. Since then Park has been considered one of the worlds premier early career mathematicians, and in 2023 won the Maryam Mirzakhani New Frontiers Prizes to commemorate this.

Park started enjoying maths in secondary school, before which she says she was not a very good maths student, and went on to be the first in her family to go to university. Park completed a degree in mathematics education from Seoul National University in 2004, and since she was unaware of what careers are available for mathematicians, subsequently worked as a mathematics teacher in secondary school until 2011. After moving to the USA with her husband and having more time on her hands, she decided to change career and was accepted to begin a Ph.D. in mathematics at Rutgers University. Despite many worries that she was "too old" or began studying "too late" or was studying "too slow", she completed her Ph.D. in 2020, which in 2022 earned her the Dissertation Prize from the Association for Women in Mathematics for her doctoral thesis.

See this YouTube video, this news article and this Quanta article for more.

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24 Eugenia Cheng (1976 - present)

Category Theory; Mathematical Education

Keywords: Women, Chinese, Non-linear career, Outreach

Eugenia Cheng is a British mathematician, author, scientific educator and musician. She received her Ph.D. from the University of Cambridge for her research in higher category theory, an abstract algebraic field which looks at *"the mathematics of mathematics"*. After taking positions in the Department of Mathematics and University of Chicago and at the Université de Nice-Sophia Antipolis, Cheng chose in 2007 to move away from the "traditional" career of the mathematician in becoming a Scientist In Residence at the School of the Art Institute of Chicago. She still holds this position today, where she continues her research in higher category theory and teaches maths classes tailored to art students.
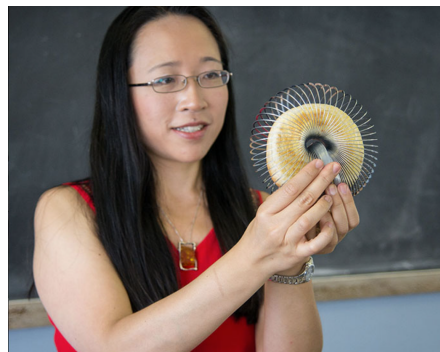
Cheng is perhaps best known for her public outreach, where she has the goal of ridding the world of "maths phobia". She believes the kind of maths taught in school is very restrictive and not useful in most peoples lives, and instead promotes teaching maths in a philosophical and open-minded method as primarily a way of logical thinking. She uses her perspective and way of thinking as a category theorist in real life to understand deep connections between human interactions. This has lead her to publish four books on topics ranging from feminism to teaching maths with cooking.

Read more on her webpage, in this interview, or watch this public lecture on YouTube.

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25   Hossein Zakeri (1942 - present)

Algebra; Commutative Algebra

Keywords: The father of commutative algebra of Iran, Iranian, ATM Flett prize in pure mathematics

Hossein Zakeri (1942-) is an Iranian mathematician. He, along with Prof. R. Y. Sharp, are the founders of generalized fractions, a branch in theory of commutative algebra which expands the concept of fractions in commutative rings by introducing the modules of generalized fractions. This topic later found applications in local cohomology, in the monomial conjecture, and other branches of commutative algebra.
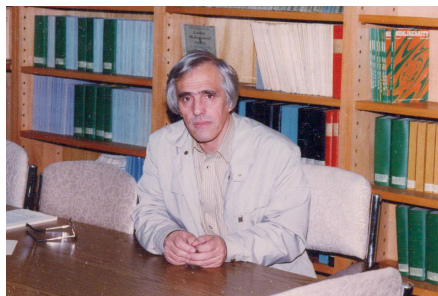
Zakeri has been named the father of commutative algebra of Iran in 2012, for his efforts and contributions in Commutative Algebra to Iranian mathematical community. The 10th seminar of "Commutative Algebra and Related Topics" of Institute for Research in Fundamental Sciences (2013), and the 24th Iranian Algebra Seminar (2014), were held in honor of him and as appreciation of his work.

Awards: First Grade Graduate Medal (1972), department of mathematics, Tabriz University. ATM Flett prize in pure mathematics for doctoral thesis, University of Sheffield, England (1982). Abbas Riazi Kermani prize (1999). Award for the outstanding visiting professor of Tarbiat Modares University (1999–2000).

Read more on Wikipedia, or ACADEMIA.

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26   Lotfi Aliasker Zadeh (1921 – 2017)

Computer Science; Fuzzy Mathematics; Artificial Intelligence

Keywords: The father of Fuzzy Logic, Iranian heritage, Guggenheim Fellowship in Applied Mathematics

Lotfi Aliasker Zadeh (1921 – 2017) was a mathematician, electrical engineer, AI researcher, and professor of computer science at the University of California, Berkeley.   Zadeh is best known for proposing (1973) fuzzy mathematics, consisting of several fuzzy-related concepts: fuzzy sets, logic, algorithms, semantics, fuzzy languages, fuzzy control, systems, fuzzy probabilities, events, fuzzy information, pattern recognition, fuzzy database, neuro-fuzzy systems, providing the first interpretable AI system based on neural network learning.

Zadeh along with John R. Ragazzini (1952) developed the Z-transform method in discrete time signal processing and analysis.

Zadeh's work also included computing with words and perceptions. His later papers include "From Search Engines to Question-Answering Systems" and "Toward a Generalized Theory of Uncertainty (GTU)—An Outline"

Zadeh was a founding member of the Eurasian Academy. Zadeh was awarded a Guggenheim Fellowship in 1967 for Natural Sciences in Applied Mathematics.

Zadeh photographed people around him. Zadeh, in an interview, expressed a readiness to transcend nationalism, emphasizing that life involves more profound concerns. He articulated, **"The real question isn't whether I identify as American, Russian, Iranian, Azerbaijani, or any other nationality. I've been influenced by diverse people and cultures, finding comfort in all of them."** In the same discussion, he acknowledged, "Persistent determination and fearlessness in navigating controversies – these traits are deeply rooted in the Turkish tradition. They are integral to my character; I can be quite resolute. This quality likely played a constructive role in the evolution of fuzzy logic." Zadeh characterized himself as "an American, mathematically inclined, electrical engineer of Iranian heritage, born in Russia."

Read more on interview, or Wikipedia, or Academic profile, or Google scholar, or watch "Celebrating the centenary of Lotfi A. Zadeh (1921-2017)" on YouTube.

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27   Sediq Afghan (1958 - present)

Philosophy of Mathematics

Keywords: Asian, Afghani, Muslim

Sediq Afghan, an Afghan philosopher and mathematician, was born on March 20, 1958, in Kabul, Afghanistan, making him 65 years old today. He is a highly respected figure in both philosophy and mathematics, having made significant contributions to both fields. Afghan is particularly well-regarded for his work in the philosophy of mathematics, a body of work that has received wide acclaim from scholars and academics.

Currently, Sediq Afghan holds the position of a philosophy professor at Kabul University. He is also a prolific author, with several books to his name on various topics in philosophy and mathematics. Moreover, he is a valued member of both the Afghan Academy of Sciences and the International Association of Philosophers.

In recognition of his outstanding research contributions in the realm of mathematics, Sediq Afghan was named the Man of the Year for 2012 by the International Biography Centre based in Cambridge, United Kingdom. The centre went a step further by creating a special medal to honour Afghan's exceptional work and dedication to the field of mathematics.

Read more on here

28   Waleed As Salam (1926 - 1996)

Polynomials

Keywords: Muslim, Iraqi, Al Salam Carlitz Polynomials, Polynomials

One of his notable contributions was a 1965 paper co-authored with Carlitz, where they introduced one-parameter generalizations of the discrete Hermite polynomials. These polynomials, labeled as $U(a)n(x)$ and $V(a)n(x)$ and known as the Al-Salam-Carlitz polynomials, can be seen as q-analogues of the Charlier polynomials from a combinatorial perspective.

Al-Salam and Carlitz not only introduced these polynomials but also provided numerous identities and relations for them. Additionally, they explicitly established the orthogonality relations of these polynomials. The moment problem associated with $V(a)n(x)$ proved to be indeterminate in certain cases. In some of these cases, Al-Salam and Carlitz identified distribution functions that served as N-extremal solutions, marking the first explicitly known instances of such solutions.

Read more in this biography

29   Cahit Arf (1910 - 1997)

Alegbra

Keywords: Turkish, Arf Invariant, Topology

Cahit Arf, born on October 11, 1910, was a prominent mathematician from the Ottoman Empire. Cahit Arf was known for his important work in algebraic number theory. He created Arf invariants, which are useful in topology. He also contributed to fields like quadratic forms in characteristic-2 fields. His name is linked to the Hasse-Arf Theorem, important in class field theory and Artin's theory of L-functions. Additionally, there are Arf rings named after him in ring theory. Arf also delved into applied math, writing papers about elastic plane bodies with free boundaries and the algebraic structure of cluster expansion in statistical mechanics. Cahit Arf passed away on December 26, 1997, in Bebek, Istanbul, at the age of 87. His collected works were published by the Turkish Mathematical Society in 1988.

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30 Khalida Inayat Noor (1946 - present)

Inequalities, Geometric functions

Keywords: Asian, Pakistani, Muslim, Women, Inequalities, Geometric functions

Khalida Inayat Noor is a Pakistani mathematician who received a prestigious award from the President of Pakistan in 2011. She's known for her research in mathematical analysis and variational inequalities. She introduced Noor Integral operator which provided to be an innovation in the field of Geometric Function. Noor has a remarkable publication record with around 300 research papers in leading international scientific journals. She's actively involved in various mathematical and educational organizations, including the Higher Education Commission of Pakistan. Noor holds the title of Chartered Mathematician in the United Kingdom and is a fellow of the Institute of Mathematics and its Applications. Currently, she works as a mathematics professor at the United Arab Emirates University. One of her papers was published in the Journal of Mathematics in October 1996, focusing on integral operators.

Read more on the University of Islamabad faculty profile

31   Subrahmanyan Chandrasekhar (1910 - 1995)

Mathematical Theory of Black Holes

Keywords: Asian

Chandrasekhar was awarded the Physics Nobel prize for his theoretical work on the gravitational collapse of stars. Between 1971 and 1983, Chandra Chandra Sekar conducted research on the mathematical aspects of black holes. His findings were documented in his work "The Mathematical Theory of Black Holes" published in 1983. He expressed that exploring the physical principles of general relativity involves allowing one's aesthetic sensibilities to guide the formulation of problems, trusting in the harmonious coherence of its mathematical structure.

   Read more on the Nobel Prize Site

32 Asghar Qadir (1946 - present)

Mathematical Sciences; Relativity; General Relativity; Cosmology

Keywords: Asian, Pakistani Mathematical Sciences

Known for His work on the mathematical sciences, relativity, Asghar Qadir is a distinguished mathematician and cosmologist from Pakistan, widely recognized for his contributions to mathematical physics and physical cosmology. He is considered one of the leading mathematicians in Pakistan, with significant achievements in fields like differential equations, theoretical cosmology, and mathematical physics. Qadir's work primarily revolves around mathematics and mathematical physics, particularly focusing on general relativity and cosmology. He has authored numerous papers in these areas, and his books, particularly "Relativity: An Introduction to the Special Theory," are widely used by science students in Asian colleges. Throughout his career, Qadir has published over 250 research papers, authored 12 books, and written numerous articles, both for research and teaching. He has collaborated with notable figures in the field, such as John Archibald Wheeler, and has made substantial contributions to the study of Black Holes. For his outstanding contributions, the Government of Pakistan honoured Qadir with the Sitara-e-Imtiaz civilian award. He has held various academic positions and played a significant role in establishing the Centre for Advanced Mathematics and Physics (CAMP) at the National University of Sciences and Technology (NUST).

Read more here

33   Muneer Ahmed Rashid (1934 - present)

Applied Mathematics; Fermat's Last Theorum; Nuclear and Quantum Mechanics

Keywords: Asian, Pakistani, Applied Mathematics

Muneer Ahmad Rashid, a Pakistani mathematical physicist and emeritus professor at the Centre for Advanced Mathematics and Physics of the National University of Sciences and Technology, has made significant contributions in areas like Special Unitary Groups, applied mathematics, theoretical and nuclear physics, SO(2), and dark energy. He transitioned from physics to mathematics, played a role in the development of the atomic bomb through critical mass calculations, and made advancements in scattering theory, optical wave scattering, and Hamiltonian harmonic oscillator theory for quantum particles. He also applied complex mathematical techniques to understand nuclear particle behaviour during testing. Rashid's specialization in mathematical physics, under the mentorship of Abdus Salam, resulted in numerous publications, including a groundbreaking proof of Fermat's Last Theorem in 2009. He also presented work on time-dependent linear harmonic oscillators and Hamiltonian mechanics. In addition to his mathematical and physical contributions, Rashid has made substantial contributions to pure mathematics, statistical mechanics, and physics.

Read more here

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34 Mohammad Abdus Salam (1926 - 1996)

Mathematical Physics

Keywords: Asian, Pakistani, Nobel Prize, Mathematical Physics

Mohammad Abdus Salam, a distinguished Pakistani theoretical physicist, received the Nobel Prize in Physics in 1979, sharing it with Sheldon Glashow and Steven Weinberg for their work on the electroweak unification theory. He was the first Pakistani and the first Muslim from an Islamic country to win a Nobel Prize in science, following Anwar Sadat of Egypt as the second Nobel laureate from an Islamic country. Salam is well-regarded as a trailblazer in promoting mathematical and theoretical physics in Pakistan during his tenure as the chief scientific advisor to the president. He understood the importance of nuclear technology for peaceful purposes in Pakistan and actively encouraged scientists to collaborate on the development of fission weapons.

In 1972, Salam founded the Mathematical Physics Group, led by Raziuddin Siddiqui, to conduct research on the theory of simultaneity during the detonation process and the mathematics involved in nuclear fission. He maintained strong connections with the theoretical physics division at the Pakistan Atomic Energy Commission (PAEC), staying informed about the progress of atomic bomb calculations.

Even after leaving Pakistan, Salam continued to support and engage with Pakistani scientists. He invited many of them to the International Centre for Theoretical Physics (ICTP) and established research programs for their benefit. Numerous prominent scientists, including Ghulam Murtaza, Riazuddin, Kamaluddin Ahmed, Faheem Hussain, Raziuddin Siddiqui, Munir Ahmad Khan, Ishfaq Ahmad, and I. H. Usmani, considered Salam as their mentor and teacher. Dr. Salam also played a crucial role in facilitating approximately 500 physicists, mathematicians, and scientists from Pakistan to pursue PhD programs in the UK and the USA.

Read more on the Nobel Prize site

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35 Baudhāyana (800 BC – 740 BC)

Trigonometry

Keywords: Pythagoras, India, Hinduism

Baudhāyana was the author of the Baudhāyana Sūtras, which are known to contain some of the earliest Indian mathematics. Little is known about him due to lack of documentation and the time having passed since his death.

The Baudhāyana Sūtras are some of the oldest Dharma related texts of Hinduism and the longest surviving that have been carried forth into recent times. They cover the Dharma (the duty to fulfil to observe custom/law), daily ritual and mathematics. This is made up of 6 key texts, with the Baudhāyana Śulbasûtra being the most relevant for advancements in mathematics.

The Baudhāyana Śulbasûtra contains the earliest written form of what we know as the 'Pythagoras Theorem', who was actually born 1000 years later than this text was published. The text states that 'The diagonal of an oblong produces by itself both the areas which the two sides of the oblong produce separately'. Due to the fact that the diagonal of a rectangle is the hypotenuse of the right-angle triangle caused by this division, it can be said to explain the same theorem as that described by Pythagoras. However, it should be noted that this text does not contain the proof even though we know it to be true. This is only one of the multiple principles described in the Baudhāyana Śulbasûtra, the list including: 'circling the square', the relation between the square root of 2 and the length of the diagonal of a square and many geometric solutions.

Read more on CueMath

36   Srinivasa Aiyangar Ramanujan (1887 - 1920)

Number Theory, Series, Continued Fractions

Keywords: Indian, Number Thoery

Ramanujan Is best known for this groundbreaking work in number theory and is credited as being one of India's greatest mathematicians.

Raised in small village near Chennai, Ramanujan had an aptitude for maths that was not hindered by his lack of a formal education. By 1902, he had devised his own method to solve the quartic and then by 1904 had managed to calculate Euler's constant to 15 decimal places and delved into the study of Bernoulli numbers and then earnt a scholarship to a government college. Despite his talents in maths his scholarship was revoked due to his immense focus on maths, leading to a disinterest in any other school subject.

In 1910 his talents were starting to be recognised after he made links between elliptic modular equations and then was published for his findings on Bernoulli numbers, defying the odds after not being able to enter university. It wouldn't be until 1912 that Ramanujan would receive any kind of mathematical education.

In 1913, he published again, this time on the distribution of primes and then a year later, after corresponding with G H Hardy (a well know mathematician for research into divergent series, Fourier series etc.), Ramanujan made the move to London to keep pursuing a career in maths. By 1916 he was awarded his Bachelor of Arts by Research degree for his work on composite number and was then elected to the London Mathematical society.

Unfortunately after suffering with prolific health problems his entire life, and the strain of an international move, Ramanujan died in 1920 at the young age of 32 after contracting Tuberculosis. However, his work lived on, his brother compiled all of his remaining notes on continued fractions and hypergeometric series, and his wife, throughout the rest of her life campaigned for Ramanujan to receive the recognition he deserved.

His work and achievements continue to be built upon and used even today. The most notable being: his Pi theorems which could closely approximate Pi, his insights into the properties of elliptic functions and the Ramanujan conjecture.

Read more on Mactutor

Latin American mathematicians

37   Jose Adem (1921 - 1991)

Algebraic Topology

Keywords: BAME, Latino

José Adem was born in Tuxpan Veracruz, Mexico in 1921, where he made all his formative studies. In 1941 he moved out to Mexico City to study the university at the UNAM (Universidad Nacional Autonoma de Mexico) where he got degrees in civil engineering and mathematics. After, with the support of Solomon Lefschetz and grants from the USA, he studied a Ph.D. in mathematics at the university of Princeton being algebraic topology as the topic of his thesis.

Adem's main contribution to the field of mathematics is the so call "Adem relations" in algebraic topology that characterizes algebraically a problem of iteration of operations with co-homological classes, which allows the algebrization of the problem of homotopy. He was a professor in the UNAM for some years until was invited to be the founder of the department of mathematics in the CINVESTAV (Centro de Investigación y de Estudios Avanzados del IPN) in 1961. This mathematics department is one of the most important research center in mathematics in Mexico and has been very important for mathematical research in Mexico and Latin America in general.

Read more in this biography.

38   Samuel Gitler (1933-2014)

Algebraic Topology

Keywords: BAME, Latino, Jewish

Samuel Gitler Hammer (1933-2014) was a Mexican mathematician of Jewish descent, known for his work in algebraic topology and expertise in Yang-Mills theory. Gitler graduated with a degree in civil engineering in 1956 from the National Autonomous University of Mexico, where he met Solomon Lefschetz. His interests soon turned to studying algebraic geometry – and subsequently algebraic topology – and in 1960 he obtained his Ph.D. from Princeton under the supervision of Norman Steenrod. After this, he took many positions in institutions across Mexico and the USA. Gitler is most well known for the "Brown-Gitler spectrum", which represents a special type of cohomology theory and led to the solution of several long-standing open problems in homotopy theory.

Along with José Adem, in 1961 Gitler founded the Mathematics Department of CINVESTAV (Centro de Investigación y de Estudios Avanzados del IPN), where both fostered a major development of exceptional mathematical activity within Mexico. Gitler succeeded Adem as chair of this institution from 1973-1981, and during this time won Mexico's National Prize for Science in 1976. Later, while serving as the Chair of the mathematics department at the University of Rochester, he was appointed in 1986 as a member of El Colegio Nacional, the highest recognition to his achievements offered by the Mexican scientific and artistic community.

Read more on Wikipedia, on nLab, or this biography.

Queen Mary
University of London

39 Artur Avila Cordeiro de Melo (1979 - present)

Dynamical Systems and Spectral Theory

Keywords: BAME, Latino

Artur Avila (1979-) is a Brazilian-French mathematician known for research in dynamical systems and spectral theory. In 2014, Avila was awarded the Fields Medal, becoming the first Latin-American to win such an award. Currently, he is a professor at the University of Zurich.

In 2001 he finished his Ph.D. thesis in dynamical systems and received the degree from IMPA. He then started a position as a postdoctoral researcher in France with Jean-Christophe Yoccoz as his supervisor, and as of 2003 he has been a researcher for the Centre National de la Recherche Scientifique (CNRS), where he would later become a research director in 2008.

Avila has made relevant contributions to his field of study. He proved, along with Svetlana Jitomirskaya, the *conjecture of the ten martinis* in 2005, as well as the *Zorich–Kontsevich conjecture* with Marcelo Viana.

In addition to the Fields Medal, Avila has received numerous other awards and honors for his work, including CNRS Bronze Medal, the Salem Prize, TWAS Prize, and Grand Prix Jacques Herbrand. He is also a foreign associate of the US National Academy of Sciences and a member of the Brazilian Academy of Sciences.

Read more on MacTutor, in this Quanta article and on Wikipedia.

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40 Alberto Pedro Calderón (1920 - 1998)

Analysis
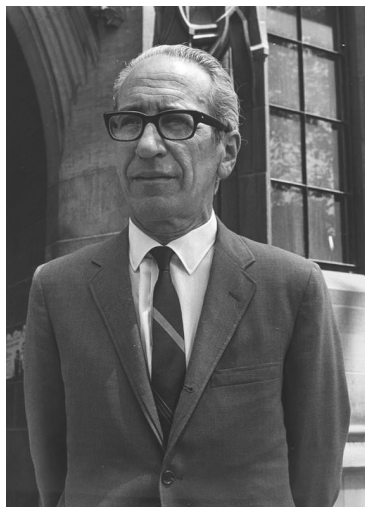
Keywords: BAME, Latino

Alberto Pedro Calderón (1920-1998) was an Argentine mathematician known for research in developing the theory of singular integral operators with Antoni Zygmund. Calderón's work ranged over a wide variety of topics: from singular integral operators to partial differential equations, from interpolation theory to Cauchy integrals on Lipschitz curves, from ergodic theory to inverse problems in electrical prospection. Calderón's work has also had a powerful impact on practical applications including signal processing, geophysics, and tomography.

He studied civil engineering at the University of Buenos Aires and graduated in 1947. After graduating he became an assistant to the Head of Electric Circuit Theory in the School of Engineering at the University of Buenos Aires and began research in mathematics under the supervision of Alberto González Domínguez. In 1948 Antoni Zygmund visited the University of Buenos Aires and began to discuss various problems with Calderón.

Calderón was awarded a Rockefeller Scholarship to enable him to undertake research at the University of Chicago and this he did, having Zygmund supervise his doctorate which was awarded in 1950. From 1950 to 1953 he was an associate professor at Ohio State University, then he spent 1954-55 at the Institute for Advanced Study at Princeton. After spending the years 1955-59 at Massachusetts Institute of Technology, he returned to Chicago in 1959 when he was appointed professor of mathematics there.

In 1958, Calderón published one of his most important results on uniqueness in the Cauchy problem for partial differential equations. In 1989, he was awarded the Steele Prize by the American Mathematical Society (fundamental research work category) for this outstanding contribution. And in 1991 he was awarded the National Medal of Science for his work on uniqueness in the Cauchy problem.

Read more on MacTutor or this excerpt from the National Academy of Sciences.

41   Luis Ángel Caffarelli (1948 - present)

Differential equations

Keywords: BAME, Latino

Luis Caffarelli (1948-) is an Argentine mathematician, regarded as one of the world's leading experts in free boundary problems and nonlinear partial differential equations. In 2023 he was awarded the Abel Prize *"for his seminal contributions to regularity theory for nonlinear partial differential equations including free-boundary problems and the Monge–Ampère equation"*. He is the first South American winner of the award.

Caffarelli earned his Master of Science (1968) and Ph.D. (1972) in mathematics at the University of Buenos Aires. He and his thesis advisor, Calixto Pedro Calderón, went on to write two joint papers: Weak type estimates for the Hardy-Littlewood maximal functions (1974); and On Abel summability of multiple Jacobi series (1974). His proudest achievement, however, was in proving a partial result of the regularity of the Navier-Stokes alongside Louis Nirenberg and Robert Kohn in 1982, which is to this day still the best known result of the (now) Millennium Problem. He currently holds the Sid Richardson Chair at the University of Texas at Austin. He also has been a professor at the University of Minnesota, the University of Chicago, and the Courant Institute of Mathematical Sciences at New York University. From 1986 to 1996 he was a professor at the Institute for Advanced Study in Princeton.

He has received numerous other awards and honors for his work, including the Bocher Memorial Prize, Rolf Schock Prize of the Royal Swedish Academy of Sciences, Leroy P. Steel Prize, the Wolf Prize, and Shaw Prize. He is a member of the National Academy of Sciences, Academy of Medicine, Engineering and Science of Texas, American Mathematical Society, Association for Women in Mathematics, and Society for Industrial and Applied Mathematics.

Read more on MacTutor, this Nature article or on Wikipedia.

Queen Mary
University of London

42   Ernesto Lupercio Lara (1970 - present)

Algebraic Topology

Keywords: BAME, Latino

Ernesto Lupercio (1970-) is a Mexican mathematician known for his contribution to algebraic topology, geometry and mathematical physics. He obtained his bachelor degree in Physic and Mathematics at the ESFM (Escuela Superior de Física y Matemáticas del Instituto Politécnico Nacional). Lupercio earned his Ph.D. under the direction of Ralph Cohen from Stanford University. The first paper published by Lupercio together with Ralph Cohen and Graeme Segal solved the conjecture proposed by James Milgram.

After finishing the Ph.D., Lupercio had a postdoctoral position in Max Planck Institut für Matematik under the supervision of de Yuri Manin. He was an assistant professor at the University of Michigan and later became a Van Vleck professor in the university of Wisconsin. During this time he solved the conjecture of Witten together with Uribe and Poddar in birational algebraic geometry. Subsequently, Lupercio returned to Mexico in order to be a researcher in the mathematics department in the CINVESTAV.

Lupercio was named Young Global Leader (Science) in the World Economic Forum (WEF) that took part in 2008. In 2007, he was named a young member of the TWAS. he was the first mathematician and Mexican in won the TWAS-ROLAC award for young Latin-American researchers. Finally, he was awarded the ICTP Ramanujan prize in 2010 for his mathematical contributions to algebraic topology and mathematical physics, as well as his contributions to young mathematics researchers in Mexico.

See more in this announcement of his receiving the Ramanujan Prize, or in this series of talks.

Queen Mary
University of London

43   Imelda Trejo

Applied mathematics, mathematical biology

Keywords: Woman, BAME, Latina

Imelda Trejo is a Mexican mathematician and a mathematical modeler and analyst of infectious diseases, cellular and molecular dynamics. She has completed her master's degree in applied mathematics at the Research Center of Mathematics (CIMAT), Guanajuato, Mexico. Trejo got her Ph.D. in Mathematics at the University of Texas at Arlington (UTA).

Trejo's research interest is in applied mathematics such as solving real-word problems by combining mathematics and computer simulations. together with her supervisor, Dr. Hristo Kojouharov, developed a mathematical model which exhibits that the correct modulation of inflammation by macrophages and progenitor bone cells secures and accelerates the healing of a bone.

During previous research, she worked on "determining whether someone has or does not have cancer by a non-invasive approach." This problem can be solved by X-Ray Computer Tomography which is an imagenological procedure and involves the following inverse problem: recovering a function in two variables given its integral lines. Her main contributions to this topic were to give an alternative proof for the best approximation of a function given only fine numbers of its integral lines. She has also worked in partial differential equations, where she used the generalized Picard-iteration method to prove two-parameter existence theorems that generalize some well-known one-parameter existence results for position problems.

Read more in this biography or her ResearchGate profile.

Queen Mary
University of London

Australian Oceanian mathematicians

44 Chris Matthews

Applied Mathematics; Mathematical Education

Keywords: BAME, Indigenous Australian, Outreach

Chris Matthews is an indigenous Australian mathematician and educator. He is one of very few indigenous Australians to earn a Ph.D. in maths, and talks about how he struggled with arithmetic as a child, only to enjoy the subject much more later when learning algebra and more "difficult" topics. Matthews' research is in applied mathematics. Most of his work has environmental applications, using partial differential equations to model and simulate various environmental challenges such as soil erosion and water flow.

Matthews also has a deep interest in mathematics education for indigenous Australians, after seeing how integral maths is for much of the policy and environmental decision making on Aboriginal land. He is the Associate Dean of Indigenous Leadership and Engagement at the University of Technology, Sydney (UTS) and the Chair of the *Aboriginal and Torres Strait Islander Mathematics Alliance* program outside of the university. In his teaching, he challenges the Western standard of teaching and attempting to incorporate more traditional Aboriginal knowledge, culture and environment, such as using traditional song and dance to teach children about multiplication.
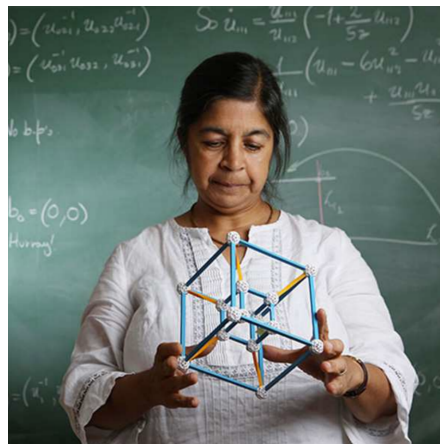
Read more is his university profile, in this interview or in this YouTube video.

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University of London

45   Nalini Joshi (1958 - present)

Integrable Systems

Keywords: Women, BAME, Burmese

Nalini Joshi (1958-) is a Burmese-Australian mathematician renowned for her work on non-linear differential equations and integrable systems. Her love of maths began as a child in Myanmar where she loved counting (particularly in the Burmese number system) and games with repetitive patterns, and continued while adjusting moving to Australia at age 12 when she would often contemplate and read about big scientific questions. Joshi wanted to be an astronaut and study astronomy, but in university she found she enjoyed maths much more. *"After trying it for a while, I realized that I could take my time, try alternative beginnings, do one step after another, and get to glimpse all kinds of possibilities along the way."*

Throughout her career, Joshi has been very vocal about promoting diversity and inclusion in academia. She co-founded the Science in Australia Gender Equity initiative, and she is very vocal about challenging the various problems she and others encounter as a woman of colour.

Joshi was formerly head of the Australian Mathematical Society, and the first female chair of applied mathematics at the University of Sydney. Her work focuses on *Painlevé* and *soliton equations*, which are differential equations describing integral systems. She employs tools from analysis, algebra, geometry and the many other interweaving areas of maths to solve these equations, and is renowned for visualising problems in different and unique ways.

"Instead of describing solutions as functions of an independent variable like time, they can be tracked by curves that go through initial values. The first perspective is like pointing a telescope to one point in the sky at night and taking pictures while time is changing. The second perspective is like tracking one star as it follows circular arcs of light in the sky at night."

See more in her university profile or these interviews from 2012 and 2017.

Disabled mathematicians

46   Ruth Fairclough (1974 - present)

Actuarial Mathematics; Statistical Cybermetrics

Keywords: Women, Disability, Non-linear career

Ruth Fairclough is a mathematician and former actuarial analyst who is currently head of the mathematics department at the University of Wolverhampton. She grew up with dyslexia, finding maths fairly easy at school but struggling with subjects like English, and since an accident at the age of 17 she has also been using a wheelchair.

After studying an undergraduate module on analytic number theory, Fairclough was turned off of the idea of studying maths further and instead searched for a job as an actuarial analyst in the finance industry. She held this job for several years and enjoyed the financial security it bought, but eventually due to facing discrimination and struggling to balance work with a growing family, she returned to university to be a lecturer in mathematics.

As a lecturer, Fairclough taught modules in financial maths, statistics and probability, and after 11 years was appointed to head of the department. She is an example of an academic with a very non-linear career path and holds this role with only a BSc (hons) from Cardiff University. Her research is in statistical cybermetrics, where she develops software and statistical methods to analyse web-based sources for social science research. In particular, her research group has produced programs which determine the sentiments expressed on social media posts, which they use for sociological research.

Read more in her web profile, in this interview, or read more about statistical cybermetrics here.

47   Antonia Jones (1943 - 2010)

Computer Programming; Number Theory

Keywords: Women, Queer, Disability

Antonia Jones (1943-2010) was a British mathematician and computer scientist. Jones contracted polio as a child and loss the ability to walk at age 10, but went on to graduate from Reading University with first-class honors. Later, she earned a Ph.D. in number theory from the University of Cambridge for her work with roots of unity and Diophantine equations.

She is best known, however, for her career in computer science, where she published numerous papers on acoustic pattern recognition, game theory and artificial intelligence (among other areas). Her work lead to the creation of the nearest neighbour (or Gamma) test for neural networks, which is widely used today in nearest neighbour analysis. Jones was also able to use her background in number theory to detect security loopholes, which she used to create high security cryptography. From her work, she also launched her own firm creating random access video controllers to improve the accessibility and ease of use of early computer models.

Read more in this brief summary, this WikiMili article, or in her obituary.
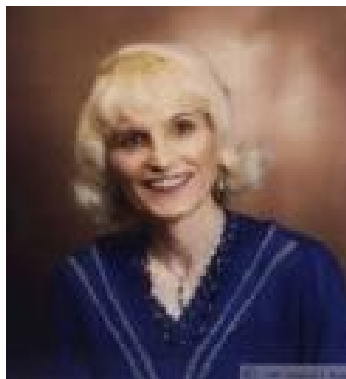
48   Kathleen Ollerenshaw (1912 - 2014)

Geometry; Recreational Mathematics; Mathematical Education

Keywords: Women, Disability, Non-academic career

Dame Kathleen Ollerenshaw (1912-2014) was an English mathematician and politician. She was deaf from the age of 8 and claimed to enjoy learning maths, although out of necessity she very quickly learned to read lips.

"Mathematics is the one school subject not dependent on hearing."

Ollerenshaw had many achievements in her life, including being appointed Dame Commander in 1970 for services to education, being appointed in Lord Mayor of Manchester in 1975, and being the founding president of the *Institute of mathematics and its applications* in 1978. She was renowned for using statistics to impact government policy on social issues and campaigning improving school standards, especially for girls.

As a mathematician, Ollerenshaw received her doctorate from Oxford University for her work on critical lattices, which describe how to most efficiently stack geometric objects. She was able to complete her Ph.D. without even submitting a thesis after submitting five papers on the subject within two years. Later in her career, she transitioned into amateur astronomy and solving recreational maths puzzles alongside her political work and education. In 1980, Ollerenshaw was the first person to create an algorithm for solving a Rubik's cube, and she also made notable breakthroughs with magic squares and many other puzzles.

See more in this article, this other article or on MacTutor.

49 Solomon Lefschetz (1884 - 1972)

Algebraic Topology; ODE's

Keywords: Disability, Outreach

Solomon Lefschetz (1884-1972) was a Jewish mathematician famous for his work in algebraic topology. Born in Russia, but raised in France, Lefschetz would move to the US in his twenties. He lost both his hands in a lab accident while working at a factory. While in an ensuing depression, he found a passion for teaching and studying mathematics, which he would do for the rest of his life. Lefschetz was based at Princeton for most of his academic career, but visited the National University of Mexico in summer months for many years later in his life. He would establish major advancements to the mathematics program at the university, so much so that he was awarded the Order of the Aztec Eagle in 1964.

In terms of research contributions, Lefschetz is credited with re-popularising the field of topology and being one of the pioneers of *algebraic topology*, where one associates algebraic structures to geometric and topological spaces to distinguish those which are not the equivalent. Several key results in this area, such as the Lefschetz fixed point theorem and Picard-Lefschetz theory, is named after him. After publishing the book *Algebraic Topology* in 1942 which summarised his work, Lefschetz went on to research differential equations, providing new approaches for solving non-linear ordinary differential equations.

Read more in this summary or on MacTutor.

50   Caryn Navy (1953 - present)

Topology; Computer Science

Keywords: Women, Disability

Caryn Navy (1953-) is a Jewish-American mathematician and computer scientist known for research in set-theoretic topology and her innovation with Braille technology to increase learning accessibility. Navy was born with limited vision, and was totally blind from the age of 10. Following her total loss of vision, she began learning to read and write in Braille, including Hebrew Braille and the Nemeth Braille system for writing mathematics. When studying maths at university, only her calculus textbook was written in Braille, and so she would also rely on audiobooks to learn. Navy's mathematical research provided groundbreaking work in set theoretic topology. In her Ph.D. thesis she constructed examples showing that para-Lindelöf topological spaces which are not paracompact. This work had consequences for Moore spaces and the development of metrisability theory, which looks at when and how topological spaces can be given a metric.

After finishing her Ph.D., Navy took a role as assistant professor in 1981, but by 1984 left academia to work on the *Raising Dot Computing* software company with her husband. Using her mathematical and computer science skills, she was responsible for testing and improving computer software designed for Braille translations. This led to the company's release of *MegaDots* in 1992, which produces Braille translations and word processing for PCs. The MegaDots product is still in use today and has revolutionised computer accessibility for people with vision impairments.

Read more in this summary or this biography.

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51   Bernard Morin (1931 – 2018)

Topology

Topology, Blind, Disabled

At the early age of 6, Morin lost his sight due to Glaucoma, however he did not let this hinder him.

Morin was born in Shanghai but after losing his vision, relocated permanently to France, where his parents felt could better accommodate his new loss of vision as he attended specialist schools for the blind. Despite his loss of vision, Morin recalls a strong interest in optical phenomena, being particular entranced by Kaleidoscopes, and despite his blindness, this interest stayed with him.

After studying mathematics at university, Morin worked as a member of the group that discovered the eversion of the sphere as well as discovering the Morin surface – a halfway model of the sphere eversion. Then in 1978, he discovered the first parametrization of Boy's surface.

Although Morin's interest in topology and his discoveries, may seem unexpected, he believed his lack of vision not only had no negative impact on his visualisation skills but instead improving it. He felt that his disability only enhanced the talents he already had and improved his 'spacial imagination' and ability to picture different shapes in his head.

Read more at 'The World of Blind Mathematicians'

52 Lev Pontryagin (1908 - 1988)

Algebra, Topology

Blind, Disabled

Born in Moscow in 1908, Pontryagin was blinded in a failed surgery at the age f 14. Subsequently, his mother read him math's textbooks and papers so that his lack of eyesight would not restrict him. Due to her lack of knowledge, Pontryagin learnt his mother's names for mathematical symbols as opposed to the actual names. He went on to study at Moscow international university.

As a student he worked on the duality theory for homology as a student, leading the Fourier Transform theorem being renamed as Pontryagin Duality. This then meant that he could solve Hilbert's fifth problem. Then in 1935, he then calculated the homology component of Lie Groups.

He also made large contributions to the field of differential equations, particularly in the theory of ordinary differential equations and dynamical systems. He is notably known for his work on optimal control theory, where he, along with his collaborators, developed the Pontryagin's maximum principle, a fundamental concept in the optimisation of dynamical systems.

Read more on The University of St Andrews Website

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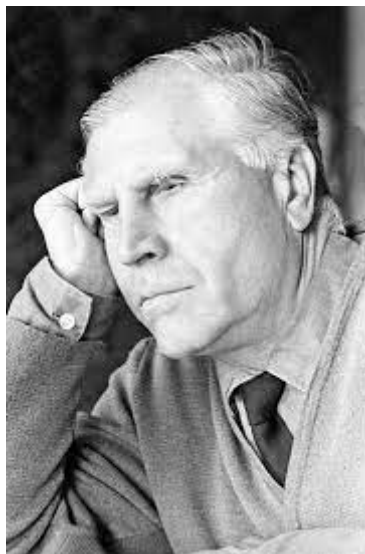
Female mathematicians

53   Claire Voisin (1962 - present)

Algebraic Geometry

Keywords: Women

Claire Voisin (1962-) is a French mathematician known for her work in algebraic geometry, with notable contributions to the Hodge conjecture, the Kodaira problem, Green's conjecture and the Lüroth problem. She obtained her Ph.D. from Paris-Sud University.

Voisin has won several awards: the European Mathematical Society Prize (1992), the Servant Prize by the Academy of Sciences (1996), the Sophie Germain Prize (2003), the Ruth Lyttle Satter Prize in Mathematics (2007), the Clay Research Award (2008), and the Shaw Prize in Mathematical Sciences (2017).

In 2009 she became a member of the German Academy of Sciences Leopoldina. In 2016, she was elected as a foreign associate of the National Academy of Sciences. That same year, she became the first female mathematician member of the Collège de France, where she currently holds the Chair of Algebraic Geometry, and she also received the Gold medal of the National Centre for Scientific Research (CNRS), the highest scientific research award in France. She was named Mathematical Sciences Research Institute (MSRI) Clay Senior Scholar for 2008-2009 and Spring 2019. She was elected Foreign Member of the Royal Society in 2021, and International Honorary Member of the American Academy of Arts and Sciences in 2022.

Read more in this biography and this AMS article.

54 Ingrid Daubechies (1954 - present)

Linear Algebra, Analysis

Keywords: Women

Ingrid Daubechies (1954-) is a Belgian mathematician and physicist with important works on wavelets in image compression.

She obtained her Bachelor's and Ph.D. degrees in Physics from Free University Brussels. In 1984 Daubechies was awarded the Louis Empain Prize for Physics. In 1987 she began working at the Mathematics Research Center of AT&T Bell Laboratories in the United States. That same year, it was a major breakthrough when she constructed compactly supported continuous wavelets, which led to many important applications.

She published *Ten lectures on wavelets* in 1992, which led her to be awarded the Steele Prize for Mathematical Exposition (1994). Daubechies was a fellow of the MacArthur Foundation from 1992 to 1997 and was elected to the American Academy of Arts and Science in 1993. In 1994 she took up her present position of Professor at Princeton University. She obtained the Ruth Lyttle Satter Prize in Mathematics in 1997. The National Academy of Sciences elected her a member in 1998, then gave her their Award in Mathematics in 2000. In 1999 she was elected to the Royal Netherlands Academy of Arts and Sciences, and obtained the Eduard Rhein Foundation Basic Research Award the next year. She received honorary degrees from various universities. She was awarded the Gold Medal of the Flemish Royal Academy of Arts and Sciences (2005), and the ICIAM Pioneer Prize (2008). Daubechies was named William R. Kenan Jr. Professor at Princeton University in 2004.

Read more on MacTutor.

Queen Mary
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55   Sofia Kovalevskaya (1850 - 1891)

Differential Equations

Keywords: Women, Historical

Sofia Vasilyevna Kovalevskaya (1850-1891) was a Russian mathematician whose contributions to the theory of differential equations are of great importance. She was born into a family of the Russian nobility that forbade her to study maths during her childhood.

At 18 years old, Sofia married palaeontologist Vladimir Kovalevsky out of convenience to pursue a higher education. In 1869 they moved to Heidelberg, where she attended lectures unofficially by Kirchhoff, Helmholtz, Königsberger, and Du Bois-Reymond, because women could not matriculate at the university. In 1871 she started studying with Karl Weierstrass. By 1874, Kovalevskaya had completed three papers on Partial differential equations, Abelian integrals and Saturn's Rings. She was granted her doctorate *summa cum laude* from Göttingen University. The couple returned to Russia and, unable to obtain an academic position, Sofia conducted no research for six years.

From 1880 she returned to her studies after an invitation from Chebyshev to the Congress of Natural Scientists in St Petersburg. In 1882 she began work on the refraction of light. Mittag-Leffler obtained for her a position as *privatdocent* in Stockholm, and she would be appointed to an extraordinary professorship the following year. Kovalevskaya was awarded the Prix Bordin of the French Academy of Sciences in 1886 for her paper on the study of rigid bodies. She also won a prize from the Swedish Academy of Sciences in 1889, and was elected a corresponding member of the Imperial Academy of Sciences. In 1891, at the height of her career, Kovalevskaya died of influenza complicated by pneumonia.

Read more on MacTutor.

56   Katherine Johnson (1918 - 2020)

Computer Programming

Keywords: Women, BAME

Katherine Coleman Goble Johnson (1918-2020) was an African-American mathematician with outstanding contributions to NASA's space programme.

Katherine entered high school at age ten and was awarded a full scholarship for West Virginia State College. Her African-American teacher William Claytor noticed her potential and helped her in her university mathematics path. In 1937 Katherine graduated with a B.S. *summa cum laude*, majoring in both mathematics and French. In 1952 Katherine applied for a position at the National Advisory Committee for Aeronautics (NACA), which would later become NASA. In 1953 she began working in the Flight Research Division. Black workers in NACA were segregated, but not after the change to NASA. Nonetheless, there was still discrimination against women: they were not allowed to attend briefings, nor put their names on research reports. Hers was the first woman's name to be credited in their division with the paper *Determination of Azimuth Angle at Burnout for Placing a Satellite over a Selected Earth Position*. It was used for the space flights by Alan Shepard (1961) and of John Glenn (1962), containing the theory necessary for launching, tracking and returning space vehicles.

Katherine retired in 1986. Among the awards she received through her trajectory are the NASA Lunar Orbiter Award, three NASA Special Achievement Awards, Mathematician of the Year in 1997 by the National Technical Association, an honorary Doctor of Law degree from the State University of New York, two honorary Doctor of Science degrees, and the Presidential Medal of Freedom in 2015.

Read more on MacTutor.

57 Ada Lovelace (1815 - 1852)

Computer Programming

Keywords: Women, Historical

Augusta Ada Lovelace (1815-1852) was an English mathematician and the first computer programmer. She was the daughter of Lord and Lady Byron. The latter encouraged her in the study of mathematics, and kept a strict attitude towards her education. Ada received her mathematical education from private tutors. In 1833 she met Charles Babbage and was fascinated by his Difference Engine. She was also friends with Mary Somerville, who provided her support for learning maths. In 1841, Lovelace began studies in advanced mathematics under De Morgan's instruction.

Lovelace produced an annotated translation called "Notes" of Menabrea's "*Elements of Charles Babbage's Analytical Machine*" in 1843. She described how the Analytical Engine could be programmed, producing what is considered to be the first ever computer program. Her "Notes" were published in 1843, and after this event, her life deteriorated until dying of cancer at 37 years of age.

Read more on MacTutor.

Queen Mary
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58   Maria Agnesi (1718 - 1799)

Calculus

Keywords: Women, Historical

Maria Gaetana Agnesi (1718-1799) is known for her work in differential calculus. She was born into a wealthy Italian family that provided her high-quality education.

In 1738 Agnesi published *Propositiones Philosophicae*, consisting of essays on philosophy and natural science. She focused on studying religious books, since she wanted to become a nun, and learning maths. Agnesi learnt mathematics from the mathematician monk Ramiro Rampinelli who helped her study calculus, and encouraged her to write a book on the subject. The mathematician Riccati aided in reading the drafts. The first volume of *Instituzioni analitiche ad uso della gioventù italiana* was published in 1748, while the second volume followed the next year. Maria gained much fame for her work. It contains no original mathematics made by her, but it does include a discussion of the cubic curve now known as the "witch of Agnesi", originally discussed by Fermat and later by Grandi.

Pope Benedict XIV appointed Agnesi to the position of honorary reader at the University of Bologna, to later be offered the chair of mathematics at the university. From 1752, Agnesi devoted herself entirely to charity and died in total poverty.

Read more on MacTutor.

59   Sophie Germain (1776 - 1831)

Number Theory

Keywords: Women, Historical, Lived in war

(1776-1831) Marie-Sophie Germain was a French self-taught mathematician to whom we now owe major contributions in number theory, acoustics and elasticity. Discouraged by her parents to become a mathematician, she studied by herself, learning also Latin and Greek to read more advanced texts.

Unable to pursue a university education for being a woman, Germain obtained many lecture notes, including Lagrange's analysis course. She engaged in correspondence with him, first under the pseudonym M LeBlanc, and he would become her mathematical counsellor. Sophie also corresponded with Gauss, who gave her number theory proofs high praise.

In the decade of 1810, Germain worked on deriving a theory of elasticity that sparked new insights, but it was not totally accepted at first due to the lack of rigorous work, a consequence of not having received proper professional training. However, she did win later the grand prize from the Paris Academy of Sciences. In 1819, Germain outlined a plan for a solution to Fermat's Last Theorem, and proved a special case of it.

Germain died in June 1831. Despite her great contributions to mathematics, her death certificate did not listed her as one, but as a "*rentier*" (property holder).

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60   Hypatia of Alexandria (370 - 415)

Geometry and Number Theory

Keywords: Women, Historical

Hypatia of Alexandria (370-415), born in Egypt, is the first known woman in mathematics who made major contributions to the field. Hypatia was the daughter of the mathematician and philosopher Theon of Alexandria. She became head of the Platonist school at Alexandria in about 400 CE. Hypatia was accused of paganism by the early Christians, and was eventually murdered for her scientific knowledge.

Despite not having evidence of any original mathematical research, it is known that she assisted her father in writing his commentary on Ptolemy's *Almagest* and in producing a new version of Euclid's *Elements*. Hypatia also wrote commentaries on Diophantus's *Arithmetica*, on Apollonius's *Conics* and on Ptolemy's astronomical works. She provided her advice to Synesius on the construction of an astrolabe and a hydroscope. Throughout her life, Hypatia was a notable compiler, editor and preserver of earlier mathematical works. However, almost all her work is lost.

Read more on MacTutor.

61   Maryam Mirzhakani (1977 - 2017)

Geometry, Dynamical Systems

Keywords: Women, Lived in war, BAME, Fields medal, Asian

Maryam Mirzhakani was a mathematician (1977-2017). Maryam grew up in a supportive family, although she lived her childhood during the Iran-Iraq war. Her middle school was at Farzanegan for girls, which is administrated by Iran's National Organization for Development of Exceptional Talents. Here, by her own initiative, she got trained to be part of the Iranian Mathematical Olympiad; to later win a gold medal at the International Mathematical Olympiad in 1994 (Hong Kong) and 1995 (Toronto).

Maryam got her degree of Mathematics in the Sharif University of Technology (1995-1999), were she published 3 papers during her degree. Later was admitted in Harvard University to do her Ph.D. under the supervision of Curtis Mc-Mullen, who won a Fields Medal in 1998 for his work in complex dynamics, hyperbolic geometry and Teichmüller theory; she got her doctorate in Riemannian surfaces in 2004. Maryam was awarded a Merit fellowship (2003), later the Leonard M and Eleanor B Blumenthal Award for the Advancement of Research in Pure Mathematics (2009) for her thesis work. Furthermore, she had the Clay Research Fellowship and joined Princeton University as Assistant Professor of Mathematics until 2008. She then moved to Stanford University as a Professor of Mathematics. Meanwhile in her personal life, Maryam married Jan Vondrák and later had a daughter Anahita in 2011. Mirzhakani also won the Ruth Lyttle Satter Prize in Mathematics (2013).

The awards continued, and in 2014 awarded the prestigious Fields medal *"... for her outstanding contributions to the dynamics and geometry of Riemann surfaces and their moduli spaces"*. Later was elected to be part of the Paris Academy of Sciences (2015), the American Philosophical Society (2015), the National Academy of Sciences (2016), and the American Academy of Arts and Sciences (2017). Mirzakhani was diagnosed with breast cancer before her Fields Medal but never stopped working. Her breast cancer later spread to her liver and bones, killing her in 2017.

Read more on MacTutor.

62   Ruth Moufang (1905 - 1977)

Abstract Algebra

Keywords: Women, Lived in war, Historical

Ruth Moufand was a mathematician (1905-1977). Ruth was born in a middle class family that encourage her and her intellectual pursuits. Ruth was taught mathematics at Realgymnasium in Bad Kreunznach (1913-1924) by Wilhelm Schwan, where she and her sister helped Schwan's geometry book with diagrams and drawings. She later joined, with no problem, the Johann Wolfgang Goethe University in Frankfurt am Main (1924-1929). In the same university she started her Ph.D. under the supervision of Max Dehn (1929-1931) on projective geometry. At this time, Carl Siegel, Ernst Hellinger, Max Dehn, Ludwing Bieberbach, Otto Szász, and Paul Epstein were teaching at this university.

After this she joined University of Rome (1931-1932), then had a teaching position in University of Königsberg (1932-1933) and later returned to Frankfurt for a lecturership (1933). This years were hard as the Nazi party came to power; as Szász, Dehn, Hellinger and Epstein were Jewish, they ended up retiring from the university. Ruth continued teaching and working on her thesis in projective planes introducing Moufang planes and Moufang loops (1931-1937). During this time she published 7 papers related to this. In 1937 she was the 3rd German woman to get her doctorate degree. Nevertheless Hitler's minister of education refused Moufang permission to teach. Due to this, in 1937 she was the first German woman with a doctorate to be employed in industry, were she focused her research now in elasticity. After WWII she returned to Frankfurt university in 1946 as a docent.

Ruth retired in 1970 and died in 1977. Her work was so significant that in 2006 a street in Frankfurt was named in her honour and in 2010 the University of Frankfurt created the Ruth Moufang Fund.

Read more on MacTutor.

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63 Emmy Noether (1882 - 1935)

Abstract algebra

Keywords: Jewish, Lived in war, Historical

Emmy Amalie Noether was a mathematician (1882-1935). Emmy was born in a wealthy jewish family and his father was well known mathematician at Erlangen, Germany. She lived in Göttingen, Germany during the WWI and was affected by the Nazi occupation before WWII.

Emmy Noether is best known for her contributions to abstract algebra, in particular, her study of invariant theory and also chain conditions on ideals of rings. She also worked in special relativity where she proved: *"To every infinitesimal transformation of the Lorentz group there corresponds a Conservation Theorem"*, known in physics as Noether's theorem.

Before women were allowed to matriculate at German universities, she sat in lectures in the University of Erlangen and University of Göttingen. It was in 1904 when she was able to matriculate to the University of Erlangen, obtaining her degree and later doctorate in 1907 under Paul Gordan's supervision.

During WWI she worked with Hilbert and Klein in the University of Göttingen under poverty conditions. Thanks to their continuous support, in 1919 Noether was given the position of *Privatdozent*. Before this, much of her work was under the name of her father or under other male mathematicians. In April of 1933 she was dismissed from her position by the Nazis due to her Jewish heritage. In October of 1933, she was invited by Anna Johnson and Pell Wheeler to visit Bryn Mawr College, USA, for a year, during which period she also collaborated at Princeton. After a short visit back to Germany, Noether was invited to return until her unexpected death. Noether died in 1935 after the detection and operation of a benign tumour.

Read more on MacTutor and Blue Stocking.

64   Mary Fairfax Somerville (1780 - 1872)

Calculus

Keywords: Women, Scottish, Historical

Mary Fairfax Somerville was a mathematician (1780-1872). Mary was born in a big family with 6 siblings, although 3 died very young. While her brothers received a good education, as a woman she did not, so her mother taught her to read but not to write. Later, she spent 1 year at Musselburgh school for girls, but promptly left to return to her home to educate herself without the approbation of her family. It was through her teacher of paint that she was indirectly introduced to Euclid's *Elements* as basis for painting, astronomy and other sciences. She later became interested in algebra as she read about it in an article in a magazine.

At the age of 24, she married Samuel Greig (1804), a naval officer, who did not support her intellectual interests, but he later died after 3 years of marriage; Mary had 2 sons with him. At this point Mary discussed mathematical problems set in the *Mathematical Repository* by correspondence with William Wallace which lead her to win the silver medal for the solution of one of those problems in 1811.

Later in 1812, Mary got married with William Somerville, who encouraged her to continue studying. In 1814 her oldest daughter and so her only child with William died. Later the family moved to London, where Mary interacted with the leading scientific circles and later in 1917 was introduced to Laplace, Poisson, Pointsot, and others during a visit in Paris. Mary continued working and published her first paper in 1826. She also translated the *Mécanique Céleste* of Laplace, which was well accepted in England. She was the first to bring the *continental* calculus to the United Kingdom via her connections to French mathematicians.

Through the years Mary was elected to many societies, including the Royal Astronomical Society (1835), the Royal Irish Academy (1834), the American Geographical and Statistical Society (1857), and the Italian Geographical Society (1870). She was also given an honorary membership of the Société de Physique et d'Histoire Naturelle de Genéve (1834), was awarded a civil pension (1834-1841) by the prime minister Sir Robert Peel and prime minister William Lamb, and received the Victoria Gold Medal of the Royal Geographical Society (1870).

Mary Somerville was a strong supporter of women's education and women's suffrage and due to this Somerville College in Oxford was named after her (1879).

Read more on MacTutor.

65   Alicia Dickenstein (1955 - present)

Algebraic Geometry

Keywords: Women, Women of colour, Lived in war, Latina

Alicia Dickenstein is an Argentinian mathematician (1955-). Alicia grew up when Argentina had several political problems, including dictatorships and a civil war. Alicia initially wanted to dedicate her life to being an educator, but after an aptitude test was encouraged to study Mathematics instead. She joined the University of Buenos Aires (UBA) (1973-1977) to study Mathematics and soon after the end of her degree she got married (1978). She was encouraged to study her Ph.D. in the USA, but due to her family she refused, so she continued at UBA to study her Ph.D. in algebraic geometry (1978-1982) under the supervision of Miguel E. M. Herrera. During her Ph.D. she gave birth to her first daughter and, in 1983, had her second son. During the following years Alicia faced difficulties together with the political problems and violence. In 1974 all the postgraduate students and researchers were fired or resigned and consequently left the country (most universities shut down for months), and her advisor died due to liver cancer (1984). Alicia was a visiting professor at several international universities and became the first woman to be director of the Department of Mathematics in the Faculty of Natural and Exact Sciences at UBA (1996-1998), finally becoming a full professor in 2009.

Among the international positions and prizes: Alicia was an Eisenbud professor at Mathematical Sciences Research Institute (MSRI) (2009-2010), also in MSRI a Simons professor (2012-2013), a Simons Senior Research Associate at ICTP, Italy (2014-2019), she received The World Academy of Sciences prize (2015), was the vice-president of the International Mathematical Union (2015-2019) and also became a Fellow of the American Mathematical Society (2018). Her research focuses on on applying algebraic geometry and combinatorics to predict behaviours of biological systems. Together with Mercedes Pérez, she created The MESSI System. Due to this, she became a Fellow of the Society for Industrial and Applied Mathematics (SIAM, 2020) and the L'Oréal-UNESCO For Women in Science International Award for the Latin America and Caribbean region (2021). Alicia is editor-in-chief of the journal *Revista de la Unión Matemática Argentina* and also is a corresponding editor for the SIAM Journal on Applied Algebra and Geometry.

Read more on Wikipedia.

66   Karen Uhlenbeck (1942 - present)

Partial Differential equations; Geometric Analysis

Keywords: Women, Abel prize

Karen Uhlenbeck is a mathematician (1942-) born in Cleveland, USA. Karen was raised in a family where books and science were easy to access. Motivated by this, she entered the University of Michigan (1964) to study Mathematics. Karen got married (1965) and due to this she decided to study her Masters degree in Brandeis University (1966), and later her Ph.D. in the calculus of variations under the supervision of Richard Palais (1966-1968). After this, she got a position in the Massachusetts Institute of Technology (1968-1969), later a position University of California, Berkeley (1969-1971). Nevertheless, during this time she faced discrimination as a woman, so she ended up in University of Illinois, Champaign-Urbana (1971-1976). She then moved to the University of Illinois, Chicago (1976) where she was promoted to full professor. Karen got married with the mathematician Robert Williams in 1988.

Due to her work in differential geometry, non-linear partial differential equations, gauge theory, integrable systems and mathematical physics, Karen received several prizes and honours. Among them: she was awarded a MacArthur Prize Fellowship (1983), moved to a professorship at the University of Chicago (1983), was elected a Member of the American Academy of Arts and Science (1985), was a member of the National Academy of Sciences (1986), was appointed Professor in the University of Texas at Austin (1988), was the Noether Lecturer of the Association for Women in Mathematics (1988), holds the Sid W Richardson Foundation Regents Chair in Mathematics, and received the President's National Medal of Science (2000). She was awarded 4 honorary doctorates: University of Illinois (2000), University of Ohio (2001), University of Michigan (2004) and Harvard University (2007). Uhlenbeck also received the American Mathematical Society's Leroy P Steele Prize (2007), was included in the 2008 class of AWM Fells by the Association for Women in Mathematics, and in 2020 was elected an honorary member of the London Mathematical Society.

Karen Uhlenbeck was the first woman to win the Abel Prize (2019) and donated half of the prize money to organisations which promote more engagement of women in research mathematics.

Read more on MacTutor.

67   Argelia Vélez-Rodríguez (1936 - present)

Differential equations

Keywords: Women, Lived in war, BAME, Black Latina

Argelia Vélez-Rodríguez is a Cuban mathematician (1936-). Argelia was born when Cuba improved the educational system for Roman Catholic families, so she attended a Roman Catholic primary and secondary school. She studied Mathematics in Marianao Institute (1952-1955) and during her degree got married with Raúl Rodríguez (1954), having her first son in 1955. After her degree, she joined the University of Havana (1955-1960) to do her Ph.D. using differential equations to study astronomical orbits. With this, she became the first Black woman to receive a doctorate in Mathematics. During her studies, Argelia also had a daughter (1959). She mentions that she never felt discriminated for either her ethinicity, or for being woman. Due to several political problems in Cuba, Argelia and her family emigrated to USA (1962), although her husband was only able to leave Cuba 3 years later.

Argelia encounter a better life in USA but also discrimination for being black and being a woman in maths. In Texas College, she got involved in education of the National Science Foundation, and later became involved in programs for black students and other minorities. She joined the Bishop College in Dallas, Texas and there became an appointed chair of the Department of Mathematical Science (1975-1978). Later, she became a manager of the Minority Institutions Science Program at the US Department of Education in Washington, D.C.

Read more on MacTutor.

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68   Maryna Sergiivna Viazovska (1984 - present)

Number theory

Keywords: Women, Fields medal

Maryna Sergiivna Viazovska is a Ukrainian mathematician (1984-). As a child she excelled in mathematics, which allowed her to enter the Kiev Natural Science Lyceum no. 145 (1998-2001), a school specialising in mathematics, physics, and computer science. Later, she studied mathematics at Taras Shevchenko National University of Kiev (2001-2005). During her degree she competed in the Mathematical Olympiad Competition in 2002, 2003, 2004 and 2005 and won the top award in 2002 and 2005. She also published her first paper in this time. Maryna then moved to do her Master's Degree at the Kaiserslautern University of Technology in Germany (2005-2007). Until 2010 she worked on her thesis and published another 3 papers in 2008, 2009 and 2010.

She was awarded an equivalent to a doctorate by the Max Planck Institute for Mathematics at the Rheinische Friedrich-Wilhelms-Universität Bonn (2010-2013) under the supervision of Don Zagier. After postdoctoral research positions at the Institut des Hautes Études Scientifiques in France, the Berlin Mathematical School and the Humboldt University of Berlin, she solved the sphere-packing problem in dimension 8 (2016) and, in collaboration with others, the sphere-packing problem in dimension 24 (2017). She was later promoted to full professor at the École Polytechnique Fédérale de Lausanne (2018) and went on to receive the 2018 New Horizons in Mathematics Prize. Due to her work, Maryna received the Ruth Lyttle Satter Prize in Mathematics (2019) and became the second woman to win the Field medal in 2022.

Read more on MacTutor.

69   Fatma Moalla (1939 - present)

Riemannian Geometry

Keywords: Women, Muslim, BAME, Lived in war

Fatma Moalla is a Tunisian muslim mathematician (1939-). Fatma Moalla's family consisted of six girls, her mother and her father who was a bookseller. Fatma was born during the WWII, where Tunisia was controlled by the Axis and after the WWII Tunisia returned to be under the domain of France. Regardless of this, she mentions having a happy childhood and pass her free with her sisters reading in her father's bookstore.

Moalla attended the Lycée de la Rue du Pacha, a leading secondary school for girls. After the award of the first part of her Baccalaureate in 1956, she moved to the Lycée Carnot of Tunis where she decide to study mathematics. Then, Moalla studied at the Institut des Hautes Études de Tunis her university and got her degree in mathematics (1957-1960). In October 1960, she obtained her French diploma for studies of higher geometry.

She wanted to continue her doctorate studies, which was possible due to the support of her father, family and a scholarship awarded by the Tunisian government. Regardless of the tense conflict between France and Tunisia in 1961, she became the first Tunisian to receive the *Aggregation Award* in France. Moalla returned to Tunisia, and was appointed as a mathematics teacher in the Lycée de la Rue du Pacha (1961-62). She was also appointed as an assistant at the just funded Faculté des Sciences Mathématique, Physiques et Naturelles where she remain during all her career, where she formed the future generations of mathematicians.

Later in 1965, Fatma became the first Tunisian woman to receive a PhD in Mathematics in France. During her career she published 4 papers on Finsler spaces. In 2017 the Tunisian Women Mathematicians' Association created the 'International Fatma Moalla Award for the Popularisation of Mathematics'.

Read more on MacTutor, African Women in Math.

70   Mary Clem (1905 – 1979)

Statistics, Computing Algorithms

Keywords: Female, Computational Methods, Statistics, Human Computer

Mary Clem was an American mathematician and known as a 'human computer'. She was a computing and auditing clerk by trade and did not receive any formal mathematics education aside from achieving her high school degree, in which maths was her weakest subject.

Her major contribution to computational methods was the 'Zero Check' technique for detecting errors. As a method of carrying out accuracy checks of her own work, she used punch cards to create formulas. This then eventually sparked her idea of the Zero Check method and her computing lab becoming one of the most powerful computing facilities of the time.

The Zero-Check method is a calculation that if all other calculations were correct would be equal to 0. This removed the need for manually checking answers as this could now be done computationally and eliminated the risk of human error. This was especially useful in assessing the accuracy of computing algorithms. Clem credits her sharp eye for detail to her lack of training in mathematics as she believed this is what made her so observant of errors in the work of others and allowed her to rectify these.

Another notable achievement was her work in 1952 as the statistical consultant to the Atomic Bomb Casualty Commission in Hiroshima.

Read more on here

71   Florence Nightingale (1820 - 1910)

Statistical Analysis

Keywords: Female, Statistics, War-time, Awards, Activist

Although being better known for her heroic work as a nurse during the Crimean war, Nightingale was also a keen statistician, an interest cultured by her father. In 1840, Nightingale sought to pursue mathematics but was dissuaded and encouraged to study more 'lady-like' subjects at her parents request. Despite this she still continued to seek tutoring and was said to be one of the tutor Sylvester's best students. Sylvester was known at the time for his research into invariants.

During the Crimean war, Nightingale was constantly campaigning for hospital reform so as to improve the conditions patients and medical staff were subject to in order to reduce the mortality rate. Through data collection, Nightingale proved through her calculations that her reform proposal would successfully reduce the mortality rate. The data she collected was used to create her Polar Area Diagram, also know as the 'Coxcomb'. This showed a coloured wedge proportional to the statistic it represented. This gave way to the modern pie chart.

Nightingales use of statistics and the invention of the pie chart was a fundamental part of the hospital reform implemented at the time. This is largely due to the fact that it simplified complex data into a visual and compelling diagram that could be easily interpreted by individuals with little knowledge of statistics. Her analytical and resilient nature was rewarded in 1874 when she became an honorary member of the American Statistical Association, in 1883, when she was awarded the Royal Red Cross and finally in 1907 when she became the first woman to receive the Order of Merit.

Read more on The University of St Andrews website

72 The ENIAC Six: Betty Holberton, Jean Jennings Bartik, Kay McNulty, Marlyn Wescoff and Ruth Lichterman and Frances Bilas Spencer

Computing and Programming

Keywords: Female, Uncredited, Coding, Awards, Human computers

These six women were pioneers in programming and were tasked with successfully programming the world's first modern computer.

In 1943, the U.S army recruited, McNulty, Jennings, Snyder, Wescoff, Bilas and Lichterman to program the Electronic Numerical Integrator and Computer (ENIAC). This was needed urgently so that ballistic missile trajectories could be calculate during World War II.

The roles of these mathematicians involved solving complex equations associated with firing tables, and they were given very little guidance to complete this massive task. At the time, the women were not granted clearance and were basing their work off of blueprints and interviews with engineers. Despite this, they were able to develop and create subroutines, nesting and more, all which still remain relevant today. The computer was used until 1955 when it was decommissioned, but up until then was used in the nuclear fission calculations and weather simulations needed in order to create the hydrogen bomb.

Ultimately the credit for this exceptional piece of work has been credited to the designers of the ENIAC, John Mauchly and John Presper Eckert, and the work of the programmers has been not widely credited. This was largely due to the stigma surrounding mathematical computation at the time as it was considered 'too tedious' for the male engineers. The neglect of these 6 mathematicians was carried on, with none of them being invited to the celebratory dinner, and when photographs emerged, suggestions of Wescoff and Lichterman being models as opposed to large contributors to the project.

In 1997, the work of these six women was finally recognised as they were inducted into the Women in Technology International Hall of Fame.

Read more via The Medium's Article; 'Remembering the Eniac Six'

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73   Dr Gladys West (1930 – present)

Mathematical modelling, Computer Programming, Applied Mathethmatics

Keywords: Female, Black, African American, Uncredited, Awards

Dr Gladys West produced work that enabled the development of the GPS, but due to her being a black female during a time where segregation was still prevalent, she is known as one of the 'hidden figures' of history.

Growing up working in the fields of Virginia, it was expected that West would follow in the footsteps of her parents and either work on the farms or on the tobacco processing plant. However due to her aptitude for maths and problem solving, West was able to graduate valedictorian and pursue mathematics at university level.

In 1956, after pursuing teaching in segregated schools, West was hired by the US navy as a computer programmer and a project manager. Then in the 60's after working on an award-winning piece of research, proving that Pluto's motion was relative to Neptune, West's talents were recognised and she began to analyse satellite altimeter data from NASA's Geodetic Earth Orbiting program, to create models of the Earth's shape, her team managed to reduce the processing time, again, proving her proficiency. This then led to her spending the 70's and 80's using programming calculate the shape of the Earth, a geoid. In order to this, West created an accurate geopotential model with complex algorithms accounting for all factors impacting the shape of the earth. This model was later used as the basis of the GPS.

In 2018, West's work finally received the deserved recognition as she was inducted to the United States Air Force Hall of Fame, one of the highest honours in space command. That same year, West won the award for "Female Alumna of the Year" at the Historically Black Colleges and Universities Awards in 2018. Then in 2021, she was awarded the prince Phillip medal by the Royal Academy of Engineering.

When asked about her experience as a black female as she rose through the ranks, West said that "I carried that load round, thinking that I had to be the best that I could be, [...] Always doing things just right, to set an example for other people who were coming behind me, especially women. [...] I strived hard to be tough and hang in there the best I could." And then speaking of the experiences of women today and the impact she hopes she has had, "We have made a lot of progress since when I came in, because now at least you can talk about things and be open a little more. [...] But they still gotta fight."

Read more on Britannica

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Queer mathematicians

74   Alan Turing (1912 - 1954)

Computer Programming; Cryptography

Keywords: Queer

Alan Turing (1912-1954) was a British mathematician and cryptographer. Nowadays the face of the £50 note and the subject of *The Imitation Game*, his research covered many areas from logic and mathematical foundations, to probability theory, to group theory, to decoding encrypted messages, to mathematical biology and to quantum mechanics. He is best known for developing the *Bombe* machine during the second world war, where he introduced novel statistical approaches to allow the machine to crack the German Enigma codes.

Turing struggled at school, as his strengths in his work lay in his creativity. This would transfer to his research, where he would produce very unconventional (but still correct) solutions compared to the standard methods taught by teachers. Sadly, later in his life, Turing was convicted of homosexuality while it was still illegal in the UK. He was open about his sexuality afterwards, but due to an Official Secrets Act he was forbidden from talking about the depression which plagued him, which lead to him taking his own life.

In academia, Turing is most famous for his theoretical work on modern computers and artificial intelligence. In 1936 he introduced the idea of *Turing machines*, which introduced the notion of "computability" and laid the framework for modern computers decades before they were built. In fact, after the second world war he would introduce code for writing computers. In 1950, he also famously proposed the *Turing test*, which we still use today to determine whether or not a computer can have its own intelligence.

Read more on MacTutor.

75   Alex Fink

Algebra; Combinatorics

Keywords: Queer, QMUL researcher

Alex Fink is a Canadian mathematician currently researching algebraic combinatorics here at QMUL. His research is primarily focused on abstract algebraic objects like tropical geometry and matroids, which can be used to solve combinatorial (counting) problems. Tropical varieties are discrete "shadows" of solution sets of polynomial equations which provide insight into the geometry of the solution set but are much easier to study, while matroids cover in a very general way what it means for a collection of objects to be "independent" of each other. Fink's research is mostly theoretical in these areas, looking at algebraic methods to distinguish different matroids or at algebraic properties which appear in tropical geometry.

Fink also holds the role of Director of Postgraduate Research for the School of Mathematical Sciences. He uses his position in this role, as well as his position within academia to further inclusivity. This includes being on the LGBTQ+ mathemtatical organisation *Spectra*'s "outlist" and as an organiser of the 2023 Queer and Trans Mathematicians in Combinatorics. His presence on this list on Spectra, in particular, was a driving factor behind some PhD students choosing to study here at QMUL.

See more in this interview or on his webpage.

76 Manil Suri (1959 - present)

Numerical Analysis; PDE's

Keywords: Queer, Indian, Outreach

Manil Suri (1959-) is an Indian mathematician and author working on numerical analysis of partial differential equations. One of Suri's main projects has been on using finite element methods for elliptic problems – which involves breaking up shapes into small pieces and finding a stable solutions to how the shape evolves over time. This led to a collaboration with engineers to implement numerical simulations which test the validity of engineering design, such as testing the strength of a car.

Suri is also the writer, and participates in many outreach activities. He is the author of three best-selling novels *The Death of Vishnu*, *The Age of Shiva* and *The City of Devi*. He is also a *New York Times* contributing opinion writer on topics such as mathematics, India and LGBTQ+ rights, including several essays about growing up gay in India. Suri is also interested in using his writing skills to increase mathematical enjoyment and engagement. This involves providing videos on mathematics, projects on mathematical education for school children, working in the intersection of mathematics and humanities, and incorporating maths in fiction.

See more on his webpage or read some of his opinion pieces here.

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77   Sian Lewis

Computer Programming; Data Analysis

Keywords: Women, Queer, Black British, Outreach, Non-academic career

Sian Lewis is the lead data scientist, machine learning engineer and analytics manager working at the global consulting firm Booz Allen Hamilton out of the US. Her work specialises in using Python for machine learning, deep learning and predictive analytics, and has landed her the role of data manager for dozens of political campaigns across the US.

Lewis is from Nottingham, but grew up in Trinidad and Tobago, and holds a masters in data science and analytics. She is also a prolific mentor and activist, with roles and responsibilities such as a data science instructor with General Assembly, providing new resources and recruitment channels for women in data science, and also founding and contributing to many groups dedicated to mentor and support women, LGBTQ+ and people of colour in business and STEM.

Read more on her personal webpage, on her Booz Allen Hamilton profile, or in this interview.

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78   Ron Buckmire (1968 - present)

Fluid Dynamics; Numerical Analysis; Mathematical Education

Keywords: Queer, Grenadian, Outreach

Ron Buckmire (1968-) is a Grenadian-American applied mathematician and mathematics educator. His love for mathematics truly kicked off when doing an undergraduate research project on hypergeometric functions, stating *"I could not believe that they would pay you to learn mathematics!"* His Ph.D. work looked at computational fluid dynamics, and much of his research uses non-standard finite difference methods to provide numerical analysis for real-world financial models.

In recent years, Buckmire has stepped into the roles of Associate Dean for Curricular Affairs at Occidental College (Oxy) and as Program Director with the National Science Foundation (NSF) in the USA. In his role with Oxy, he overseas all academic initiatives and is responsible for improving the curriculum, and in his role with the NSF he has the responsibility of allocating funding to initiatives which improve undergraduate mathematics eductation throughout the US. He takes particular pride in his students who graduate with a mathematics degree and go on to teach school children.

Buckmire is also a proud advocate for opening up opportunities in STEM for margianlised groups. He is a co-founder of the LGBTQ+ mathemtatical organisation *Spectra*, holds positions in many committees for improving mathematics education, equity, diversity and inclusion, and publishes many articles in these areas.

Read more in this brief summary, his profile at Oxy, or this interview.

Queen Mary
University of London

79   Marina Logares (1976 - present)

Differential Geometry; Yang Mills Theory

Keywords: Women, Queer

Marina Logares (1976-) is a geometer and mathematical physicist currently based out of Universidad Complutense de Madrid in Spain. Logares is best known for publishing the book *Las geometrías y otras revoluciones* on the history of geometry. Her work primarily focuses on Yang-Mills Equations, which are partial differential equations realting to the geometry and curvature of spaces, and have been used to describe the behaviour of fundamental particles in physics.

Logares is also well known for her public engagement and social commitment to increase the rights and inclusivity of women and LGBTQ+ people. She is known for presenting public talks on the history of mathematics and the impact of geometry, and in 2019 she was listed among the most influential LGBTQ+ people in Spain. Over her career she has played active roles in institutions in Madrid, Porto, Bonn, Oxford and Plymouth.

Read more in this interview, in this list of influential LGBTQ+ people in Spain, or on the social media handle @MarinaLogares.
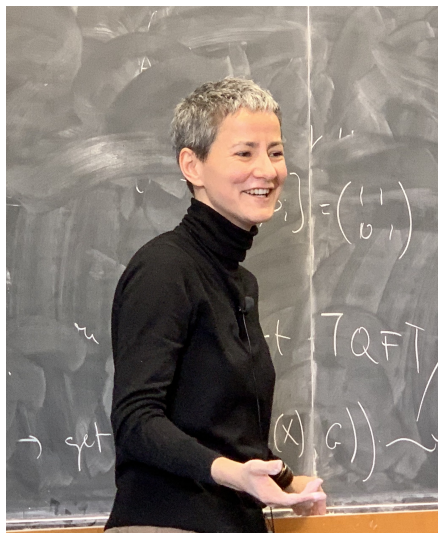
80 Audrey Tang (1981 - present)

Computer Programming

Keywords: Queer, Transgender, Taiwanese, Non-academic career

Audrey Tang (1981-) is a self-taught Taiwanese software programmer and political activist. They first rose to prominence in 2014 as a hacker in support of government protests calling for democratic governance and transparent working practices. In response to this, Tang was appointed the first Digital Minister of Taiwan, where she is notably the first transgender and non-binary official in the Taiwanese government. While in the role, they have applied their programming skills to implement a series of successful programs on digital platforms to combat misinformation and fake news. Most notably, Tang was responsible for "hacking the coronavirus" in Taiwan; setting up a "Mask Map" which provided up-to-date information of where to access masks, inventing a digital method of contact tracing, and tapping into social media and meme culture in order to spread facts.

Tang is a prominent user of the *Haskell* and *Perl* programming languages, and made many contributions to free software programming even before their political involvement. They were responsible for hundreds of projects in the early 2000s, among which led to the creation of (what is now called) the *Raku* language. She has also made significant contributions to the internationalisation and localisation of open-source software, including (but certainly not limited to) translations of books into traditional Chinese.
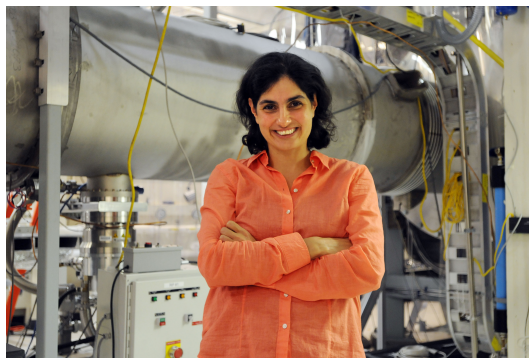
Read more in this summary, this article or in this interview.

81   Nergis Mavalvala (1968 - present)

General Relativity; Data Analysis

Keywords: Women, Queer, Pakistani

Nergis Mavalvala (1968-) is a Pakistani physicist known for her leading work in the discovery of gravitational waves. Her Ph.D. work solved the problem of how to precisely align mirrors less than a metre wide separated by four kilometres, and this method is implemented today in LIGO to detect gravitational waves. She began working in the field well before most people had heard of gravitational waves, and her work has been an integral part of an international collaboration of thousands of scientists.

In 2014, Mavalvala and her group were working on the quantum technologies being implemented in the Advanced LIGO system. When the new system came online, the group needed to validate the data analysis techniques of the new system by feeding fake signals into the data stream and seeing if these signals were detected. This was important, because the project was able to detect gravitational waves which produced very strong signals compared to the signals from background noise with high statistical significance.

Mavalvala was a recipient of the MacArthur genius award in 2010, was named LGBTQ Scientist of the year in 2014, and in recent years she was appointed Dean of the School of Sciences at MIT. She is also renowned for her advocacy in challenging racial and social injustices in STEM.

See more in this summary or in this interview.

82   Ludwig Wittgenstein (1889 - 1951)

Logic

Keywords: Queer

Ludwig Wittgenstein (1889-1951) was an Austrian philosopher, regarded as one of the greatest philosophers of the 20th century. He is best known for writing *Tractatus Logico-Philosophicus* during World War I (published in 1922, and would later became his doctoral thesis), writing *Philosophical Investigations* (published posthumously in 1953), and for his lectures in philosophy of mathematics, logic and language at the University of Cambridge between 1929–1947.

Wittgenstein began his academic career studying aeronautical engineering in Manchester. After a failed experiment, he began studying more mathematics for his research and became so interested in the subject that he left engineering to become a student of the logician Bertrand Russell at Cambridge. At Cambridge and for the rest of his academic career, Wittgenstein would study the philosophy and foundation of mathematics, most notably providing profound insight in the philosophy of language.

On a sad note, Wittgenstein was a gay man who suffered with depression throughout his life. He lived most of his life as a recluse, and changed career paths on many occasions in the hopes to fulfill purpose in his life.

Read more on MacTutor or this article.

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83   Emily Riehl

Category Theory

Keywords: Women, Queer

Emily Riehl is a mathematician based at John Hopkins University in the US. She is considered one of the worlds leading researchers in category theory, mostly working with abstract algebraic structures known as ∞-categories and model structures. She has stated she has wanted to be a researcher in maths since watching Jurassic Park at the age of 9, and ended up in category theory after taking a course in a one year program at the University of Cambridge.

"When I was an undergraduate I was really attracted to abstract algebra. I found the proofs really satisfying. If you're proving something that relies on some sort of geometric intuition or visualization, I never felt sure that I had it 100% correct."

On top of her research, Riehl is well-known for being the author of multiple textbooks on category theory, her blog *n-Category Café*, running online courses on *edX*, co-founding the LGBTQ+ mathematical association *Spectra*, and appearing on *Numberphile* and *WIRED* (among other things). Riehl has also committed herself to always ask one question at the end of any talk she attends to help with everybody's understanding of the topic and to change the tone to promote more open-ended dialogue. (This is a great reasons to ask questions in tutorials and lectures!)

See more on Riehl's personal webpage, in her interview with Quanta, her video with Numberphile, or her video with WIRED.

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84   Tyler Kelly

Algebraic Geometry; Mathematical Physics

Keywords: Queer, Non-binary

Tyler Kelly is an American mathematician currently doing research in geometry at the University of Birmingham. Their work primarily focuses on mirror symmetry, which links algebraic geometry to symplectic geometry and its applications in mathematical physics. In particular, Kelly looks at what properties in symplectic geometry for a given object can be interpreted as 'mirrored' by properties for a corresponding object in algebraic geometry that can be studied with more straightforward techniques from abstract object.

Kelly is also passionate about diversity in STEM, particularly with promoting cases for women and LGBTQ+ people. They currently sit on the London Mathematical Society's Women and Diversity in Mathematics Committee, which supports maths departments across the UK at offering equal opportunities in work practices. They also helped organise the 2020 and 2022 LGBT STEMinars, which is a conference for LGBTQ+ people in all fields of STEM to present their diverse range of work.

See more on their University of Birmingham profile, in this interview or on Twitter @TyLKelly.

85   James Stewart (1941 - 2014)

Calculus; Harmonic Analysis

Keywords: Queer, Outreach

James Stewart (1941-2014) was a Canadian mathematician and musician, who was initially drawn to maths when his high school teacher showed his class a proof that the irrationals are uncountable. In his research he is most known for his work in harmonic analysis. Stewart is most famous for his series of calculus and precalculus texts which have been used in undergraduate courses around the world from the 1980s to the current day (although not at QMUL). While working on the first of these textbooks, Stewart would say that *"with [his] teaching, research and writing, [he] worked 13 hours a day for 364 days of the year"*.

Stewart had many passions beyond his research, most notably his love of music and hosting concerts, which he pursued alongside maths throughout his career. He was also an out gay man for all of his adult life, and was one of the leaders of the initial LGBT liberation movement in his hometown of Hamilton. Stewart also took great interest in his students wellbeing and success, and was a highly regarded teacher for this reason. To ensure students received the best education possible, he would constantly update his textbooks to incorporate more up-to-date and engaging teaching methods and content.

Read more in this article, this interview or here.

86   Katrin Wehrheim (1974 - Present)

Topology, Gauge Theory

Keywords: LGBTQ+, Female, Activist, Awards

Katrin Wehrheim was born in 1974 and currently works at University of California Berkeley. Their main interests are symplectic topology and gauge theory.

Wehrheim came out as gay at the MIT women's maths conference and has promoted and encouraged increased visibility for women and the Queer community in academic settings, with a focus on STEM. They live by the belief that 'it is important for LGBT people to be proud and visible not just for themselves, but also for everyone who comes after them to show the next generation that their sort of life has been lived before and it's still possible to do [maths]'.

Wehrheim is making steps in mathematical research to simplify and untangle overly complex language used in papers to increase accessibility and encourage curiosity into the area. Another key moment in Wehrheim's career so far was the NSF career awards in 2009, which helps fund activities at MIT for women in maths.

An aim of Wehrheim's current research is to investigate the links between symplectic topology and Gauge Theory, complex geometry, and low-dimensional topology, using discoveries made in their previous research into the construction of invariants for three-manifolds and knots.

Read more on University of Berkeley profile.

87   Georg Joachim von Lauchen Rheticus (1514 - 1574)

Trigonometry

LGBT, Trigonometry, Historic

Rheticus is mostly known as being Copernicus' only student and the founder of the trigonometric tables.

He grew up in the town of Feldkirch where he was raised by his German father and Italian mother. His father took on the role of his teacher, until during Rheticus' mid-teens, where he was unfortunately beheaded due to accusations of sorcery.

He later went on to study at the University of Wittenburg where he achieved his masters. It was also here where he met Philipp Melanchthon, who had worked closely with Martin Luther (best known for sparking the protestant reformation), his close relationship with Melanchthon led to a teaching position in maths and astronomy at the university.

In 1538, under the mentorship and encouragement of Melanchton, Rheticus left to go and study under the worlds best astronomers, sparking his working relationship with Copernicus. He studied under Copernicus for 2 years and in that time was solely responsible for the trigonometric sections of Copernicus' De Revolutionibus, which he was also the catalyst for getting published. In Rheticus' section he outlined cosine and sine. Then in his own pamphlet titled Canon of the Science of Triangles, Rheticus became the first to publish tables for all 6 trigonometric tables in relation to right-angled triangles opposed to circles.

In 1551, Rheticus was working as a member of the theological department in Leipzig where he began an affair with one of his students. Upon the discovery of this, Rheticus was forced to leave Leipzig or face prosecution. Despite not being present at trial, he was sentenced to 101 years in exile.

He spent the last years of his life studying and practising medicine in Krakow as well as working further on his trigonometric tables.

Read more at MacTutor

88   Peter Landin (1930 – 2009)

Calculus, Coding

Keywords: LGBT, Awards, Computing, Coding, Activist

Landin was a Bisexual computer scientist, whose discovery of the 'off-side rule' and the application of Lambda calculus in programming languages, changed the face of computer programming.

From a young age, Landin showed clear aptitude for maths, having completed his Cambridge maths degree in 2 years. During the 60's he moved to New York and then later Massachusetts before returning home and taking on a role at Queen Mary University of London where he worked on building up the computer science department.

Landin wanted to create a programming language that would not be tied to one machine but could rather be used across different machines and manufacturers. This led him to using Lambda calculus to model a new language. By using Lambda calculus as the basis for his coding he was able to integrate it into his own language, ISWIM, which used higher order functions, automatic storage management and abstract syntax notation. This language became the basis of LISP, ML and Haskell. His work, also led to the introduction of 'Landin's Off-side Rule', which describes the indentation rule commonly used in Python. This was published in his paper, 'The Next 700 Programming Languages', and is vital in ensuring the structure and scope of the code.

Aside from his ground-breaking work in computer science, Landin was an avid campaigner for LGBT rights, and as Bisexual himself was close to the cause and was actively involved with the Gay Liberation Front during the 70's. He separated from his wife in 1973, and began to pursue gay politics, hosting dinner parties in his London flat and encouraging fundraisers and protests. Towards the end of his life Landin shifted away from computer science as he felt it had become a capitalist subject with a focus on profit making and was ashamed of the turn it was making.

Read more via this paper

Diversifying the Maths Curriculum

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